UNIVERSITY OF BRISTOL.

THE ANNUAL REPORT

OF THE

Agricultural and Horticultural Research Station

(THE NATIONAL FRUIT AND CIDER INSTITUTE),

LONG ASHTON, BRISTOL,

1914.

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INTRODUCTION.

Since the previous Annual Report was issued, further progress has been made with the new buildings at Long Ashton. The new laboratories have been completed and have been in use since the beginning of January, 1914 All rooms required by the present staff have been suitably fitted; the fittings in the remainder will be completed as additional appointments are made.

The new wing to the cider house was finished in time for the latter part of the 1913–14 season's work. It has since been in use continuously. Various machines and fittings have been installed in the new wing, including carbonating and bottling machines, a filter pulp washer, a large slate blending vat, bottle-washing apparatus, and a lift running from the basement to the top of the building.

It has not been found possible to make much progress with the alterations to the old part of the cider buildings, the work being hindered in the first place by a local strike in the building trades, and afterwards by the outbreak of the war. It has been decided that the completion of the building scheme should be deferred for the present; but several minor alterations to the old buildings which require immediate attention are being carried out. The cellar in the old wing of the cider buildings was converted into a temporary fruit room for the storage of the market apples and pears in the autumn of 1914. Since it was found that this answered well for the purpose, it is probable that it will be permanently used in this way, and that there will thus be no occasion to erect a separate fruit room until further storage capacity is required.

The new buildings were formally opened on June 26th, 1914, by the Right Hon. Walter Runciman, M.P., at that time President of the Board of Agriculture and Fisheries. There was a large attendance of subscribers to the Capital Fund, members of the University, and landowners and agriculturists from the area served by the Station.

Dr. A. E. Lechmere, M.Sc., has been appointed mycologist to the Station. It is unfortunate that owing to his presence in Germany at the outbreak of the war, and his subsequent detention there, he has not yet been able to take up his duties. Mr. G. T. Spinks, B.A., has

been temporarily appointed to carry on the mycological work during Dr. Lechmere's absence. Mr. J. W. Eves, who had acted as pomologist since the establishment of the Department, has resigned his post, having received an appointment elsewhere.

During the summer of 1914, Mr. S. P. Wiltshire, M.Sc., one of the Research Scholars of the Board of Agriculture and Fisheries, was engaged in research at the Station. It is expected that he will return during the coming summer to continue his investigations on Apple Scab and Apple Canker.

The University, in 1913, appointed Mr. W. Nixon Live Stock Officer for the Bristol Province. It was originally decided that Mr. Nixon should be stationed at Gloucester; but, since it was found that he could work more conveniently from Bristol as a centre, it has been arranged that he should use the Research Station as his headquarters.

The war has interfered considerably with the work of the Station, several of the labour staff being away on military service. Owing to shortage of labour in the district difficulty has been found in filling their places. Among those called up for service was Mr. H. Watts, who was in charge of the practical cider work. Mr. E. P. West, the Manager-Secretary, volunteered to take charge of the practical work in the cider house; and as a result, it has not been seriously hampered by the absence of the cider-maker. It is feared, however, that until the end of the war the work, both in the laboratories and the fruit plantations, will be to some extent hindered owing to lack of labour.

The planting of the land previously occupied by the old cider orchard has been completed. Part of it has been utilised for the collection of varieties of market apples and pears on the Paradise stock which had been gradually worked up in the Nursery. Since enough land for all the young bushes was not available at the Station, the Ashton Court Estate very kindly placed temporarily at the disposal of the Station a portion of its nursery, and the trees will be grown there for the next season or two until arrangements can be made to take in more land. A number of trained trees of peaches, nectarines, apricots, cherries, plums and pears have been planted along the new walls built around the enclosed garden. The garden itself is occupied mainly with seedling apples, raspberries, gooseberries, currants and strawberries, which have been raised during the past few seasons at the Station. A small plot in the garden has been set aside for the cultivation of strawberries, the intention being to grow strawberries continuously on this plot and to treat the soil in various ways as it shows signs of becoming exhausted, in order to determine how far the same land can be profitably used for continuous strawberry cultivation. The question is a somewhat important one, since in some districts, *e.g.*, the Cheddar neighbourhood, the

land suitable for strawberry cultivation is limited in extent, and continuous cropping is in such cases practically a necessity.

In the vinery a number of best known varieties of vines and figs have been planted. The orchard house has been given up to the culture of fruit trees in pots. These are being used extensively for fruit breeding purposes. A collection of blackberries and other members of the Rubus family possessing useful fruiting characters is being made with the object of conducting a series of hybridising experiments. A number of loganberry seedlings have already been obtained and planted out on the banks of the raised ground on which the laboratories stand. Considerable progress has been made with the work on various types of apple fruit stocks, details of which are given in a separate section of this Report.

As regards nursery work, about 1,300 standard trees of cider apples and perry pears were available for distribution in the autumn of 1914. The whole of these have been sent out, a number of new trial orchards in the contributing Counties having been established with them. Particulars of these will be found in the section of the Report relating to County orchards. As soon as more land can be obtained, a fresh cider and perry nursery will be established. There will be a large number of trees available for distribution next autumn. Any members or associates of the Institute desiring to obtain any should make early application.

The Staff of the Department, has, during the past year, co-operated with the Agricultural Organisers of the Counties of the Bristol Province in carrying out a series of joint field demonstrations on the manuring of grass land and of mangels. In connection with this work Mr. Gimingham has visited each of the centres at which the experiments were being carried on and has made an examination of the soil in each case.

In September last, the Board of Agriculture and Fisheries organised a series of experiments on the preservation of fruit and vegetables by drying, canning, and other methods. In connection with this work the Board made a grant of £50 to the Department to cover the cost of certain preliminary experiments, which were conducted in co-operation with Dr. Hamilton, at Studley College, and Mr. C. S. Martin, at Dunnington Heath. This work has now been developed, and two experimental factories are being carried on at Dunnington Heath and Broom Junction.

Mention must be made of the loss which the National Fruit and Cider Institute has sustained in the death of Mr. A. E. Brooke-Hunt. Mr. Brooke-Hunt, in his capacity of Superintending Inspector of the Board of Agriculture, was mainly responsible for the foundation of the Institute in 1903, and from that time until his retirement from the Board of Agriculture took a most active part in its affairs and a very close personal interest in its work. To him very largely

was due the support given at the outset to the Institute by the six contributing counties, and the maintenance of their interest and financial help during the first few critical years of its existence.

It is desired to acknowledge the assistance which has been received in the experimental work from Messrs. E. P. West, W. Camps, and J. Coombes. Mr. West, in addition to his very considerable duties as Manager-Secretary, undertook, as mentioned above, the charge of the practical work in the cider house in the absence of the regular cider-maker, and has been at all times ready to be of assistance in the fruit experiments also. Mr. Camps, as head laboratory assistant, has rendered invaluable service both in supervising the installation of the fittings in the laboratories and also in assisting in many of the research investigations. The whole of the apple juice analyses recorded in the following pages have been made by him. Since the departure of Mr. Eves the records of the Fruit Department have been kept by Mr. Coombes, who as Fruit Foreman, has also been responsible for the carrying out of the cultural experiments in the fruit plantations.

The following is a list of publications by the staff of the Department in 1914 :—

(1) Annual Report of the Department for 1913.

(2) Report on the work of the National Fruit and Cider Institute for 1913 (*Bath and West Journal*, Vol. VII).

(3) B. T. P. Barker and C. T. Gimingham, " Further Observations on the Fungicidal Action of Bordeaux Mixtures," *Journal of Agricultural Science*, Vol. VI., No. 2.

(4) B. T. P. Barker and C. T. Gimingham, " The Action of Bordeaux Mixtures on Plants," *Annals of Applied Biology*, Vol. I, No. 1.

(5) B. T. P. Barker and O. Grove, " A Bacterial Disease of Fruit Blossom," *Annals of Applied Biology*, Vol. I., No. 1.

(6) C. T. Gimingham, " The Scouring Lands of Somerset and Warwickshire," *Journal of Agricultural Science*, Vol. VI., No. 3.

(7) C. W. Spiers, " The Estimation of Tannin in Cider," *Journal of Agricultural Science*, Vol. VI., No. 1.

SINGLE VARIETY CIDERS AND PERRY, 1913–1914.

By B. T. P. Barker and Otto Grove.

During the season 1913–14 a number of varieties of cider apples and perry pears were tested again in the cider-house for vintage quality. The method of treatment was that which has already been described in earlier reports. Details of the characters of the individual ciders are given below.

The summer of 1913 having proved so hot and dry, it was expected that the quality of the fruit and of the cider would be well above the average. The accompanying table shows that, while in the case of a few juices, such as Kingston Black, Nos. 1 and 4, higher gravities than the normal for the variety were obtained, most of the gravities did not rule particularly high, and in some cases, such as Cherry Norman, they were appreciably lower than usual. The acidities, as anticipated, were decidedly lower than those of the previous year in the case of sweet and bitter-sweet varieties. The sharp varieties, however, did not present any great variation from the results of 1912-13. The amount of tannin, while not being remarkably high, was probably fairly up to the average. The most striking feature for the season was the comparatively low rate of fermentation which was shown by the great majority of the juices. This feature, combined with the somewhat low acidity of the sweet and bitter-sweet varieties, was undoubtedly responsible for the very considerable number of outbreaks of sickness which occurred during the summer of 1914. In fact, cider sickness was, perhaps, more prevalent among the Institute ciders then, than in any previous season.

CIDERS.

Sharp Varieties. (Juice containing normally more than .45 per cent. malic acid.)

Bickington Grey (Newton Abbot, Devon).

Analysis of fresh juice, 20th November, 1913:

Specific gravity	1·050
Malic Acid	1·01%
Tannin	·20%

Weight of fruit, 1,009lbs.
Yield of juice, 751lbs.
Average daily fall in specific gravity at 28°C., .003.
Filtered 8th December, 1913. Specific gravity, 1.033.
Specific gravity in bottle, 1st May, 1914, 1.030.

REMARKS : A very sharp cider, retaining considerable sweetness. Flavour and aroma very good.

Too acid for use alone, but valuable for blending.

Brice's Kernel (Tewkesbury, Gloucester).

Analysis of fresh juice, 12th November, 1913 :

Specific gravity	1.045
Malic Acid	·64%
Tannin	·15%

Weight of fruit, 512lbs.
Yield of juice, 407lbs.
Average daily fall in specific gravity at 28°C., ·0043.
Filtered 8th December, 1913. Specific gravity, 1·032.
Specific gravity in bottle, 1st May, 1914, 1·023.

REMARKS : A thin, somewhat sharp cider, of moderate sweetness. Flavour and aroma indifferent.

Lacking in quality for use alone.

Cap of Liberty (Martock, Somerset).

Analysis of fresh juice, 20th November, 1913 :

Specific gravity	1·050
Malic Acid	·78%
Tannin	·25%

Weight of fruit, 1,050lbs.
Yield of juice, 825lbs.
Average daily fall in specific gravity at 28°C., ·0026.
Filtered 12th January, 1913. Specific gravity, 1·033.
Specific gravity in bottle, 1st May, 1914, 1·027.

REMARKS : A rather sharp and sweet cider with fair aroma and flavour.

Useful for blending. Not quite up to the usual standard for this variety. The fruit was in rather poor condition.

Cowarne Red (Boddington, Gloucester).

Analysis of fresh juice, 13th November, 1913 :

Specific gravity	1·050
Malic Acid	·41%
Tannin	·21%

Weight of fruit, 970lbs.
Yield of juice, 749lbs.
Average daily fall in specific gravity at 28°C., ·0036.
Specific gravity in bottle, 1st May, 1914, 1·029.

REMARKS : A sweet, moderately brisk cider, with good body, flavour, and aroma.

An excellent cider unblended in the early part of the season, deteriorating slightly, however, as the summer advanced.

Dymock Red (Ledbury, Hereford).

Analysis of fresh juice, 11th November, 1913:

Specific gravity	1·054
Malic Acid	·50%
Tannin	·23%

Weight of fruit, 966lbs.
Yield of juice, 722lbs.
Average daily fall in specific gravity at 28°C., ·0041.
Filtered 5th January, 1914. Specific gravity, 1·030.
Specific gravity in bottle, 1st May, 1914, 1·021.

REMARKS: A moderately sweet, medium sharp cider of good body, flavour, and aroma.
Useful alone or for blending.

Kingston Black (Martock, Somerset).

Analysis of fresh juice, 19th November, 1913:

Specific gravity	1·069
Malic Acid	·59%
Tannin	·25%

Weight of fruit, 4,423lbs.
Yield of juice, 3,488lbs.
Average daily fall in specific gravity at 28°C., ·0028.
Filtered 16th February, 1913. Specific gravity, 1·039.
Specific gravity in bottle, 1st May, 1914, 1·036.

REMARKS: A rich, sweet cider, with a fair degree of briskness. Flavour and aroma pleasant and well developed.
An excellent cider unblended, thoroughly typical of the variety.

Kingston Black (Pendock, Gloucester).

Analysis of fresh juice, 29th October, 1913:

Specific gravity	1·069
Malic acid	·67%
Tannin	·13%

Weight of fruit, 2,030lbs.
Yield of juice, 1,520lbs.
Average daily fall in specific gravity at 28°C., ·0046.
Filtered 1st December, 1913. Specific gravity, 1·033.
Specific gravity in bottle, 1st May, 1914, 1·031.

REMARKS: A rather sharp cider of some sweetness. Flavour and aroma very fair.
A useful cider alone, although not so good as some of the other ciders made from the same variety.

Kingston Black (Tewkesbury, Gloucester).

Analysis of fresh juice, 6th November, 1913:

Specific gravity	1·053
Malic Acid	·48%
Tannin	·20%

Weight of fruit, 1,148lbs.
Yield of juice, 870lbs.
Average daily fall in specific gravity at 28°C., ·0055.
Filtered 1st December, 1913. Specific gravity, 1·035.
Specific gravity in bottle, 1st May, 1914, 1·026.

REMARKS: A moderately brisk and sweet cider. Flavour and aroma very fair.
Useful alone, but below the best standard for the variety.

Kingston Black (Thornbury, Gloucester).

Analysis of fresh juice, 6th November, 1913:

Specific gravity	1·059
Malic Acid	·57%
Tannin	·10%

Weight of fruit, 854lbs.
Yield of juice, 679lbs.
Average daily fall in specific gravity at 28°C., ·0051.
Filtered 1st December, 1913. Specific gravity, 1·032.
Specific gravity in bottle, 1st May, 1914, 1·029.

REMARKS: A sweet cider of some degree of briskness. Flavour and aroma good.
Very useful unblended.

Pople's Gutter Apple (Oldbury, Gloucester).

Analysis of fresh juice, 18th December, 1913:

Specific gravity	1·043
Malic Acid	·73%
Tannin	·25%

Weight of fruit, 1,169lbs.
Yield of juice, 922lbs.
Average daily fall in specific gravity at 28°C., ·0072.
Filtered 12th January, 1914. Specific gravity, 1·022.
Specific gravity in bottle, 1st May, 1914, 1·016.

REMARKS: A medium, rather sharp, thin cider of indifferent quality. The fruit was in comparatively poor condition at the time of making.
Moderate for blending.

Pull Court Red (Tewkesbury, Gloucester).

Analysis of fresh juice, 13th November, 1913:

Specific gravity	1·050
Malic Acid	·53%
Tannin	·20%

Weight of fruit, 982lbs.
Yield of juice, 717lbs.
Average daily fall in specific gravity at 28°C., ·0077.
Filtered 1st December, 1913. Specific gravity, 1·031.
Specific gravity in bottle, 1st May, 1914, 1·020.

REMARKS: A moderately sweet, medium sharp cider of very fair aroma and clean flavour.
Useful for blending with richer sorts, and fairly satisfactory alone.

Red Soldier (Ledbury, Hereford).

Analysis of fresh juice, 11th November, 1913:

Specific gravity	1·053
Malic Acid	·73%
Tannin	·18%

Weight of fruit, 940lbs.
Yield of juice, 737lbs.
Average daily fall in specific gravity at 28°C., ·0039.
Filtered 8th December, 1913. Specific gravity, 1·030.
Specific gravity in bottle, 1st May, 1914, 1·023.

REMARKS: A sharp cider, with a fair degree of sweetness. Flavour and aroma moderately good.
Useful for blending.

Skyrme's Kernel (Boddington, Gloucester).

Analysis of fresh juice, 4th December, 1913:

Specific gravity	1·054
Malic Acid	·57%
Tannin	·22%

Weight of fruit, 976lbs.
Yield of juice, 622lbs.
Average daily fall in specific gravity at 28°C., ·0026.
Filtered 16th February, 1914. Specific gravity, 1·026.
Specific gravity in bottle, 1st May, 1914, 1·022.

REMARKS: A moderately sweet cider of medium acidity, with no special quality of aroma or flavour. Requires blending. This sample fell below the usual standard for this variety, probably owing to the poor condition of the fruit at the time of milling.

Yellow Styre (Tewkesbury, Gloucester).

Analysis of fresh juice, 23rd October, 1913:

Specific gravity	1·058
Malic Acid	·62%
Tannin	·06%

Weight of fruit, 1,170lbs.
Yield of juice, 926lbs.
Average daily fall in specific gravity at 28°C., ·0036.
Filtered 24th November, 1913. Specific gravity, 1·036.
Specific gravity in bottle, 1st May, 1914, 1·029.

REMARKS: A brisk and sweet cider of fair quality, lacking, however, in distinction.

Fairly good alone, but better for blending.

Yeovil Sour (Martock, Somerset).

Analysis of fresh juice, 4th December, 1913:

Specific gravity	1·048
Malic Acid	·38%
Tannin	·19%

Weight of fruit, 860lbs.
Yield of juice, 701lbs.
Average daily fall in specific gravity at 28°C., ·0032.
Filtered 12th January, 1914. Specific gravity, 1·026.
Specific gravity in bottle, 1st May, 1914, 1·024.

REMARKS: A thin, medium sweet, and rather insipid cider, lacking in character. Flavour and aroma moderate.

Unsatisfactory alone; fairly useful for blending with the richer bittersweet types.

Sweet Varieties. (Juice containing normally less than .45 per cent. malic acid and .2 per cent. tannin.)

Large White (Martock, Somerset).

Analysis of fresh juice, 19th November, 1913:

Specific gravity	1·050
Malic Acid	·23%
Tannin	·18%

Weight of fruit, 3,601lbs.
Yield of juice, 2,866lbs.
Average daily fall in specific gravity at 28°C., ·0041.
Filtered 15th December, 1913. Specific gravity, 1·033.
Specific gravity in bottle, 1st May, 1914, 1·028.

REMARKS: A sweet cider of moderate body and fair flavour and aroma. Lacking in briskness for use alone, but serviceable for blending.

Queen Anne (Martock, Somerset).

Analysis of fresh juice, 29th October, 1913.

Specific gravity	1·048
Malic Acid	·13%
Tannin	·05%

Weight of fruit, 2·069lbs.
Yield of juice, 1,754lbs.
Average daily fall in specific gravity at 28°C., ·0043.
Filtered 1st December, 1913. Specific gravity, 1·021.
Specific gravity in bottle, 1st May, 1914, 1·017.

REMARKS: A thin, insipid cider devoid of character and of rather unattractive flavour and aroma.

Moderate for blending, and unsuited for use alone. Fruit overripe at the time of milling.

Slack-ma-Girdle (Newton Abbot, Devon).

Analysis of fresh juice, 12th November, 1913:

Specific gravity	1·049
Malic Acid	·21%
Tannin	·13%

Weight of fruit, 2,175lbs.
Yield of juice, 1,655lbs.
Average daily fall in specific gravity at 28°C., ·005.
Filtered 8th December, 1913. Specific gravity, 1·036.
Specific gravity in bottle, 1st May, 1914, 1·032.

REMARKS: A full-bodied sweet cider representing the best type of the sweet class.

Lacks briskness for use alone, but valuable for blending.

Truckle (Martock, Somerset).

Analysis of fresh juice, 26th November, 1913:

Specific gravity	1·059
Malic Acid	·32%
Tannin	·18%

Weight of fruit, 1,156lbs.
Yield of juice, 844lbs.
Average daily fall in specific gravity at 28°C., ·0042.
Filtered 5th January, 1914. Specific gravity, 1·028.
Specific gravity in bottle, 1st May, 1914, 1·027.

REMARKS: A sweet cider with rather more briskness than is usual with ciders made from the sweet class of apples. Flavour and aroma fairly pleasant, but lacking in special character.

Useful for blending.

Bittersweet Varieties. (Juice containing normally less than .45 per cent. malic acid, and more than .2 per cent. tannin).

Ashton White (Long Ashton, Somerset).

Analysis of fresh juice, 14th October, 1913:
- Specific gravity .. .. .. 1·048
- Malic Acid .. .. .. ·17%
- Tannin .. .. ·33%

Weight of fruit, 1,190lbs.
Yield of juice, 940lbs.
Average daily fall in specific gravity at 28°C., ·0065.
Filtered 28th October, 1913. Specific gravity, 1·028.
Specific gravity in bottle, 1st May, 1914, 1·020.

REMARKS: A rather bitter, medium sweet cider of poor flavour and aroma. Lacking in body. Decidedly below the standard of some previous seasons.

Indifferent for blending.

Cadbury No. 1 (North Cadbury, Somerset).

Analysis of fresh juice, 29th October, 1913:
- Specific gravity .. .. .. 1·051
- Malic Acid .. .. .. ·24%
- Tannin .. .. ·32%

Weight of fruit, 2,232lbs.
Yield of juice,
Average daily fall in specific gravity at 28°C., ·0045.
Filtered 2nd December, 1913. Specific gravity, 1·026.
Specific gravity in bottle, 1st May, 1914, 1·023.

REMARKS: A typical bittersweet cider of inferior merit. Moderately sweet with indifferent flavour and aroma.

Of moderate value for blending.

Cherry Norman (Bosbury, Gloucester).

Analysis of fresh juice, 4th November, 1913:
- Specific gravity .. .. .. 1·045
- Malic Acid .. .. .. ·16%
- Tannin .. .. ·26%

Weight of fruit, 867lbs.
Yield of juice, 687lbs.
Average daily fall in specific gravity at 28°C., ·007.
Filtered 24th November, 1913. Specific gravity, 1·019.
Specific gravity in bottle, 1st May, 1914, 1·016.

REMARKS: A thin cider of moderate sweetness. Flavour and aroma poor. Indifferent for blending. Much below the usual standard of the variety.

Colebrook (Martock, Somerset).

Analysis of fresh juice, 29th October, 1913:
- Specific gravity .. .. .. 1·059
- Malic Acid .. .. .. ·19%
- Tannin .. .. ·22%

Weight of fruit, 550lbs.
Yield of juice, 390lbs.
Average daily fall in specific gravity at 28°C., ·0051.
Filtered 24th November, 1913. Specific gravity, 1·022.
Specific gravity in bottle, 1st May, 1914, 1·012.

REMARKS: A rather strong cider of the dry type, deficient in character and of unattractive flavour and aroma.

Moderately useful for blending.

Duke of Bedford (Oldbury, Gloucester).

Analysis of fresh juice, 4th December, 1913:

Specific gravity	1·042
Malic Acid	·22%
Tannin	·20%

Weight of fruit, 950lbs.
Yield of juice, 801lbs.
Average daily fall in specific gravity at 28°C., ·0057.
Filtered 15th December, 1913. Specific gravity, 1·028.
Specific gravity in bottle, 1st May, 1914, 1·021.

REMARKS: A very thin cider of inferior aroma and flavour.

Indifferent for blending. This was the first trial of this variety, and the fruit was in very good condition at the time of milling. It seems probable that the variety is of altogether inferior merit for vintage purposes.

Farmer's Friend (Martock, Somerset).

Analysis of fresh juice, 29th October, 1913:

Specific gravity	1·049
Malic Acid	·17%
Tannin	·20%

Weight of fruit, 1,170lbs.
Yield of juice, 946lbs.
Average daily fall in specific gravity at 28°C., ·0053.
Filtered 10th November, 1913. Specific gravity, 1·027.
Specific gravity in bottle, 1st May, 1914, 1·020.

REMARKS: A medium sweet cider of pleasant aroma and flavour, but somewhat insipid.

Fairly useful alone in spite of its low acidity, but improved by suitable blending.

Horner (Martock, Somerset).

Analysis of fresh juice, 20th November, 1913:

Specific gravity	1·054
Malic Acid	·16%
Tannin	·26%

Weight of fruit, 880lbs.
Yield of juice, 660lbs.
Average daily fall in specific gravity at 28°C., ·0052.
Filtered 12th January, 1914. Specific gravity, 1·032.
Specific gravity in bottle, 1st May, 1914, 1·029.

REMARKS: A sweet, fairly full-bodied cider, with slight astringency. Aroma pleasant; flavour fair, but insipid.

Satisfactory when blended with sharper types.

Jersey No. 2 (North Cadbury, Somerset).

Analysis of fresh juice, 4th December, 1913:

Specific gravity	1·052
Malic Acid	·15%
Tannin	·28%

Weight of fruit, 2,129lbs.
Yield of juice, 1,711lbs.
Average daily fall in specific gravity at 28°C., ·0038.
Filtered 16th February, 1914. Specific gravity, 1·022.
Specific gravity in bottle, 1st May, 1914, 1·016.

REMARKS: A moderately sweet cider of fair aroma and flavour, but possessing no special feature of merit.
Useful for blending, but lacking in character alone.

Jersey No. 4 (North Cadbury, Somerset).

Analysis of fresh juice, 4th December, 1913:

Specific gravity	1·050
Malic Acid	·19%
Tannin	·22%

Weight of fruit, 2,220lbs.
Yield of juice, 1,770lbs.
Average daily fall in specific gravity at 28°C., ·005.
Filtered 15th December, 1913. Specific gravity, 1·032.
Specific gravity in bottle, 1st May 1914, 1·029.

REMARKS: A sweet, slightly astringent cider. Full bodied and of pleasant aroma and flavour.
Good for blending, but deficient in acidity for use alone.

Little Wilding (Ledbury, Hereford).

Analysis of fresh juice, 20th November, 1913:

Specific gravity	1·053
Malic Acid	·16%
Tannin	·23%

Weight of fruit, 928lbs.
Yield of juice, 672lbs.
Average daily fall in specific gravity at 28°C., ·0068.
Filtered 15th December, 1913. Specific gravity, 1·033.
Specific gravity in bottle, 1st May, 1914, 1·025.

REMARKS: A fairly sweet cider with slightly marked astringency. Flavour and aroma fair.
Useful for blending.

Masters' Jersey (North Cadbury, Somerset).

Analysis of fresh juice, 18th December, 1913:

Specific gravity	1·058
Malic Acid	·18%
Tannin	·30%

Weight of fruit, 2,083lbs.
Yield of juice, 1,514lbs.
Average daily fall in specific gravity at 28°C., ·0043.
Filtered 23rd February, 1914. Specific gravity, 1·033.
Specific gravity in bottle, 1st May, 1914, 1·026

REMARKS: A typical Somerset bittersweet cider. Sweet and of very fair flavour and aroma. Useful for blending, but lacking in briskness alone.

Middle Streak (North Cadbury, Somerset).

Analysis of fresh juice, 23rd October, 1913:
- Specific gravity .. .. .. 1·051
- Malic Acid .. .. .. ·17%
- Tannin .. .. ·30%

Weight of fruit, 2,202lbs.
Yield of juice, 1,787lbs.
Average daily fall in specific gravity at 28°C., ·0061.
Filtered 2nd December, 1913. Specific gravity, 1·025.
Specific gravity in bottle, 1st May, 1914, 1·022.

REMARKS: A moderately sweet, somewhat astringent cider of fair body. Flavour and aroma lacking in quality.
Moderate for blending.

Pocket Apple (Newton Abbot, Devon).

Analysis of fresh juice, 12th November, 1913:
- Specific gravity .. .. .. 1·052
- Malic Acid .. .. .. ·33%
- Tannin .. .. ·20%

Weight of fruit, 1,275lbs.
Yield of juice, 1,005lbs.
Average daily fall in specific gravity at 28°C., ·0041.
Filtered 12th January, 1914. Specific gravity, 1·031.
Specific gravity in bottle, 1st May, 1914, 1·026.

REMARKS: A sweet cider with slight trace of astringency. Flavour and aroma very fair.
Blended with sharper sorts, gives satisfactory results.

Royal Jersey (Martock, Somerset)

Analysis of fresh juice, 13th November, 1913:
- Specific gravity .. .. .. 1·053
- Malic Acid .. .. .. ·21%
- Tannin .. .. ·38%

Weight of fruit, 1,140lbs.
Yield of juice, 882lbs.
Average daily fall in specific gravity at 28°C., ·0044.
Filtered 12th January, 1914. Specific gravity, 1·027.
Specific gravity in bottle, 1st May, 1914, 1·024.

REMARKS: A rather sweet, markedly bitter cider. Full-bodied and of very fair aroma and flavour.
Useful for blending with lighter types.

Royal Jersey (Martock, Somerset).

Analysis of fresh juice, 4th December, 1913:
- Specific gravity .. .. .. 1·051
- Malic Acid .. .. .. ·21%
- Tannin .. .. ·28%

Weight of fruit, 1,099lbs.
Yield of juice, 878lbs.
Average daily fall in specific gravity at 28°C., ·0051.
Filtered 16th February, 1914. Specific gravity, 1·025.
Specific gravity in bottle, 1st May, 1914, 1·020.

REMARKS: A moderately sweet cider of pleasant aroma and flavour, typical of the medium bitter-sweet class. Requires blending.

Strawberry Norman (Ledbury, Hereford).

Analysis of fresh juice, 26th November, 1913:

Specific gravity	1·052
Malic Acid	·35%
Tannin	·32%

Weight of fruit, 947lbs.
Yield of juice, 701lbs.
Average daily fall in specific gravity at 28°C., ·0061.
Filtered 15th December, 1913. Specific gravity, 1·033.
Specific gravity in bottle, 1st May, 1914, 1·025.

REMARKS: A rather sweet and bitter cider of fair quality. Useful for blending with sharp varieties.

Twistbody Jersey (Martock, Somerset).

Analysis of fresh juice, 11th November, 1913:

Specific gravity	1·061
Malic Acid	·20%
Tannin	·45%

Weight of fruit, 1,695lbs.
Yield of juice, 1,269lbs.
Average daily fall in specific gravity at 28°C., ·0053.
Filtered 12th January, 1914. Specific gravity, 1·034.
Specific gravity in bottle, 1st May, 1914, 1·028.

REMARKS: A sweet cider with marked tannin character. Aroma pleasant and flavour good. One of the best of the bitter-sweet types for the season. Very good for blending.

White Norman (Bosbury, Hereford).

Analysis of fresh juice, 4th November, 1913:

Specific gravity	1·054
Malic Acid	·21%
Tannin	·23%

Weight of fruit, 855lbs.
Yield of juice, 611lbs.
Average daily fall in specific gravity at 28°C., ·0034.
Filtered 8th December, 1913. Specific gravity, 1·030.
Specific gravity in bottle, 1st May, 1914, 1·027.

REMARKS: A sweet cider of fair body, with a certain degree of astringency. Flavour and aroma fairly good. Satisfactory when blended with sharper types.

PERRY.

Coppice Pear (Malvern, Hereford).

Analysis of fresh juice, 14th October, 1913.

Specific gravity	1·051
Malic Acid	·38%
Tannin	·08%

Weight of fruit, 1,268lbs.
Yield of juice, 999lbs.
Average daily fall in specific gravity at 28°C., ·0053.
Filtered 24th November, 1913. Specific gravity, 1·021.
Specific gravity in bottle, 1st May, 1914, 1·017.

REMARKS: A medium sweet, thin perry with a fair degree of briskness, but unattractive aroma and flavour.
Deficient in character for use alone.

THE TREATMENT OF CIDER SICKNESS.

By Otto Grove.

Most of the juices from the varieties of cider apples made into cider during the season 1913–14 showed a very slow fermentation; and as experience has shown that slow fermenting juices are especially liable to sickness, a good deal of this very serious disease among them was anticipated. As a matter of fact, sickness turned up during the spring of 1914 in many of the sweeter ciders. Ciders made from the following varieties went sick: Sweet Alford, Pocket Apple, Slack-ma-Girdle, Royal Jersey, Taylor's Bitter, Horner, Truckle, Duke of Bedford, Gatcombe Apple and Master's Jersey. All these juices contained less than ·5 per cent. of malic acid and had been filtered when the specific gravity had reached 1·025—1·030; so they possessed a fair amount of sweetness.

Ciders filtered early, with comparatively high specific gravities and containing over ·5 per cent. of malic acid, are not, as a rule, very liable to sickness; but during last season a case of sickness occurred in a Kingston Black cider containing ·59 per cent. of malic acid. This cider showed a remarkably slow fermentation, the gravity only falling from 1·069 to 1·039 in the course of three months. It was filtered when the gravity had reached that point and went sick four months later.

Several experiments in casks were carried out to remedy or prevent sickness, and for those experiments a Sweet Alford juice was used. This juice showed a very slow fermentation, the original gravity being 1·049 at the making on October 12th, 1913; and this had only fallen to 1·036 on February 2nd, 1914, when it was filtered. Sickness started two months later. The following experiments were started in April with several casks of the Sweet Alford cider, all of which showed the beginning of sickness.

(1) To a 50 gallon cask of a cider of 1·025 specific gravity, and containing ·21 per cent. of malic acid, were added 22·5 grams of sulphur dioxide gas (1 part to 10·000 parts of cider). The cask was left for six weeks and examined. The specific gravity had fallen three points, and a distinct smell and flavour of sickness had developed. The sample was kept for about six months, but the

sickness symptoms increased, and the cider became quite undrinkable.

(2) Thirty gallons of the same Sweet Alford cider were mixed with 30 gallons of a sharp cider (Bickington Grey, sp. gr. 1·030, acid 1·01 per cent.); the mixture had a specific gravity of 1·029 and contained ·5 per cent. of malic acid. After six weeks there was no smell or taste of sickness, and the blend was of a very pleasant, brisk character. The gravity had fallen to 1·025. After six months the cider was still very good and no sickness developed.

(3) To a 30 gallon cask of the same Sweet Alford cider was added 4 grams of tartaric acid per litre (about 4lbs. per 100 gallons). The specific gravity was 1·031 and the acidity brought up from ·21 per cent. to ·56 per cent. by the addition of the tartaric acid. After six weeks no sickness had developed, and the specific gravity remained the same. To another cider showing the beginning of sickness, but in a less pronounced degree than the Sweet Alford, was added 2lbs. of tartaric acid per 100 gallons. No sickness developed, although it occurred in a cask of the same cider kept as a control.

(4) To a 60 gallon cask of the sick Sweet Alford cider was added half a gallon of thick brewer's yeast. The yeast had first been carefully washed by stirring it up with cold water, which was poured off when the yeast had settled down. The yeast deposit was then again stirred up with fresh water, and this operation was repeated four times, until the yeast became quite white without smell or taste of hops. The specific gravity of the cider was 1·027, and the acidity ·21 per cent. A strong fermentation started, and after six weeks the cider was filtered. The specific gravity was then 1·008, and the cider had no smell or taste of sickness: but it was, of course, rather dry, as it had been allowed to ferment so far. Experiments on the same line were carried out with other sick ciders in the beginning state of sickness, and it was found, that it is not necessary to ferment as far down as in the above-mentioned case to prevent sickness. For instance, another cider made from a mixture of fruit, the juice having a specific gravity of 1·056, and an acidity of ·37 per cent., was filtered when the gravity in the course of three months had fallen to 1·037; and as it developed sickness later on, to one cask was added washed brewer's yeast. It was allowed to ferment down to 1·015 before filtering. This cask did not develop sickness; and the cider remained very good and kept clear and sound for over the six months during which it was held in store.

(5) A cask of the same Sweet Alford cider was aerated by means of blowing air through it for a few hours every day for a fortnight, it being possible that the acceleration of the fermentation produced by the aerating would be detrimental to the development of the sickness bacillus. This was, however, not the case. After six weeks

the specific gravity had fallen to 1·016, and the cider was very badly attacked by sickness.

As a conclusion of the above experiments, it can be said that when a cider is supposed to be liable to sickness, or when the first indications of the disease are noted, it is possible to remedy or prevent the sickness by one of the above-mentioned methods 2, 3 or 4. The methods 2 and 3 have really the same object, namely, to augment the amount of acid present, the acid acts as a preventive of the growth of the sickness bacillus. If a cider made of sharp apples is at disposal, it can be added to the cider beginning to show signs of sickness in such a proportion that the acidity of the mixture is at least ·5 per cent. If tartaric acid is used to augment the acidity, about 2lbs. per 100 gallons of cider will in most cases be sufficient.

The first method is, of course, the most natural, as no foreign body is introduced into the cider, but there can be no objection to using the tartaric acid in the proportions mentioned, as it is a natural constituent of many fruits, especially of grapes, from which it is made for commercial uses. As to the treatment with brewer's yeast it has the disadvantage that it reduces the sweetness of the cider, and cannot be used if it is desired to keep the cider at the original high gravity, because to ensure a good result it is necessary to ferment the cider 10–15 points down, thus changing it from a sweet cider to a drier one. It has not yet been settled how far down it is necessary to let the cider ferment, but it will probably be found that at least a drop of 10 points is necessary. This naturally differs with the different juices and the degree of sickness present.

Instead of brewer's yeast, pressed yeast (German yeast) can be used in the proportion of about 2lbs. per 100 gallons of cider. Pressed yeast has the advantage that it does not contain any hop-particles and does not need washing, as it has already been washed in the yeast-factories. It must, of course, be quite fresh.

It is possible that in many cases sickness could be prevented by accelerating the first vigorous fermentation of the juice and by repeated early racking. The acceleration can be carried out by keeping the casks at a higher temperature (60–65° F.), by keeving, and also by adding a certain proportion of phosphate of ammonia as a yeast-food (1 oz. per 100 gallons). The bacillus causing the sickness is probably only present in small quantity in the original juice, and would in many cases be eliminated by a vigorous fermentation and repeated racking.

ACETIFICATION IN CIDER.

By Otto Grove.

One of the greatest enemies of cider is the vinegar ferment (acetic acid-producing bacteria), which, as is well-known, in a short time can transform the best cider into a sour, undrinkable liquid. It has been mentioned several times in the reports from this Institute; but it cannot be repeated too often that a sure remedy against this very common disease is to keep the cider out of touch with the air. The micro-organism which transforms the alcohol in the cider into acetic acid can only do so when air is present. Consequently, when air is excluded, no acetification will occur. As long as a vigorous fermentation takes place in the juice, and the yeast is in strong activity, there is not much danger of the acetic ferment starting, because the development of carbonic acid gas produced during fermentation acts as a disinfectant against the acetic acid-forming bacterium. Consequently, when working according to the usual method, *i.e.*, fermenting the juice in the casks turned upon their sides and completely filled, there is no danger in leaving the bung-hole open during the first 12–14 days; but after this time, when the strong fermentation has stopped, and no more froth is discharged from the bung-hole, it is indispensable that the bung-hole should be closed in such a way that the fermentation gas can escape, but that no air from outside can get into the cask.

There have been made several different forms of apparatus to achieve this object, all working upon the same principle, that is, forming a liquid trap, through which the fermentation gas escapes. We have introduced a model of a trap this season, which has worked very satisfactorily. It is easily fixed in the bung, and is also very cheap. It consists of a U-shaped glass tube, with two bulbs, opposite each other. One end of the U-tube is longer than the other, and is bent completely over just above its bulb. It is fixed vertically through a hole bored in a cork fitting into the bung-hole of the cask. The cork may be with advantage dipped into melted paraffin-wax before it is used. This treatment makes it completely air-tight. In the U-tube is placed a little water, so that about one-third of each of the two bulbs is filled. It is better to

use instead of water a mixture of equal parts of water and glycerine, to prevent evaporation. The fermentation-gas will bubble through the glycerine-water, but no air can enter from outside.

When the cider is finished and kept in casks tightly bunged down, it is often found that it is difficult to keep the usual small bungs airtight, especially as they have to be removed now and again for the purpose of refilling the cask to replace the cider lost by evaporation. It is not a good plan to use paper or sacking for tightening up the bungs, because the paper very often bursts, and the sacking is wet and porus, allowing air to enter, and very often nursing a powerful breed of acetic-bacteria in its loose tissue. We have introduced a new kind of bung, which has given entire satisfaction. As a matter of fact, not one of over 100 casks kept closed down with this type of bung showed the least trace of acetification, although many of them were kept at a rather high temperature, which is very favourable for the development of the acetic ferment.

The bung is of a long and tapering shape, made of wood and covered with several layers of canvas treated with paraffin-wax. The wooden bung has the following dimensions : Diameter of bottom end, $1\frac{7}{8}$ inches ; ditto of top end, $2\frac{5}{8}$ inches ; length, $7\frac{1}{2}$ inches. The bungs used here are made of ash-wood, but it does not matter much what kind of wood is used, as long as it does not split too easily and does not communicate any flavour to the cider. The canvas cover is fixed in the following way : A piece of canvas is cut according to a suitable shape, of a sufficient size to go round the bung 3–4 times, covering the sides of the wood completely with exception of an inch or so left bare at the top. A saucepan with melted and hot paraffin wax is kept ready, and the wooden bung inserted into the liquid wax, which is brought to cover its sides and bottom completely, dipping it several times, so that the wax soaks well into the wood. The wood must, of course, be thoroughly dried first. Before the wax has set, the canvas is rolled tightly round the bung, and the whole is again dipped into the melted wax, so that the canvas is completely permeated. This bung is driven into the bung-hole by a wooden mallet. The bung-hole must be of such a size that $\frac{1}{3}$–$\frac{1}{2}$ of the length of the bung enters the cask, dipping into the cider. The role of the paraffin-waxed canvas is to give the surface of the bung a certain elasticity, so that small irregularities in the shape of the bung-hole are filled up.

In addition to its other advantages this bung is very easily removable, because a good hold can be got on the part outside the cask. It can also be used year after year, being comparatively imperishable.

PURE YEAST FERMENTATION EXPERIMENTS.

By Otto Grove.

During last season some experiments were made on the employment of pure yeasts for the fermentation of apple-juice. The use of pure yeast, which is now general in most fermenting industries has for some years been more or less successfully practised with apple juice in several countries. The types of yeast employed are either selected from the different kinds of yeasts naturally present in fermenting apple-juice, or pure yeast from other sources, *e.g.*, wine-yeast, are employed. The objects, as explained in previous Reports, are in the first place to get a more regular and cleaner fermentation, and also to improve upon the aroma and flavour of the cider by suppressing the growth of undesirable yeast-types or other micro-organisms present in the juice. When using yeast from wine, the yeast is cultivated from wines, which are known for their fine aroma and flavour, and as the yeast, through the fermentation, contributes to the bouquet of the wine, it is to be expected that a part of the aromatic bodies, developed by the action of the yeast, are also produced, when the wine-yeast is cultivated in apple-juice instead of grape-juice. The experience has shown that in many cases a great improvement has been obtained by using such a selected yeast for the fermentation of apple-juice.

The pure yeast is cultivated in special vessels containing a sterilized, favourable medium—in our case, apple-juice, — and, when a sufficient crop of yeast is obtained, it is added to the bulk of the material to be fermented, which can either be previously heated to such a temperature that all living cells present in it are killed—as, for instance, in the brewing industry—or used in its natural state. In the first case the yeast will be alone and without competition from other micro-organisms; in the second case there is already a varying quantity of different kinds of yeast and other living germs present. It is clear, that a much cleaner and more regular fermentation is obtained, when it is possible, by heating or otherwise, to destroy undesirable micro-organisms already present in the material before adding the selected yeast. In the case of apple-juice there

is, however, the difficulty that heating affects the flavour. It will very probably be possible to remedy this to a certain extent by heating to a comparatively low temperature, which, without killing all the micro-organisms, will affect them in such a way that their vitality is seriously set back, thereby making them less dangerous as competitors to the selected yeast. Possibly a treatment with ultra-violet rays, which can be made at a very low cost (a few pence per 100 gallons), when the necessary apparatus is at hand, would be efficient to bring about the desired sterility of the juice. Experiments on these lines will be carried out later.

As it is, the method we have followed is to add the selected yeast to the freshly pressed juice in large quantities, so that it has the opportunity of out-growing the other micro-organisms already present in the juice. We have cultivated each type of yeast in a specially made tinned copper-vessel (Carlsberg tin) containing about 2 gallons of sterilized apple-juice, adding one of these cultures in full fermentation to a hogshead of 54–60 gallons of freshly expressed apple-juice.

The cultures of pure yeast, which have been developed and are kept in the laboratory at a suitable temperature, are, according to our results, more sensitive to unfavourable circumstances than the natural yeast found in the juice; and especially is that the case as regards temperature. It is therefore necessary for obtaining good results with pure yeast, that the temperature of the fermenting liquid should be kept sufficiently high to be favourable to the growth of the selected yeast. The temperature generally considered the best in dealing with apple-juice is about 60° F., and this temperature must be kept at any rate during the beginning of the fermentation. For most juices it will be sufficient to keep that temperature for 5–6 weeks, or until the fermentation has proceeded to the point wished, *e.g.*, to a specific gravity of 1·025. When that is reached, a lower temperature is desirable, especially if the cider is filtered. If a low temperature, *e.g.*, 40–45° F., is maintained during the first period of the fermentation, the pure yeast added will not be able to develop well, and the different, natural yeasts in the juice will get the upper hand; and consequently the pure yeast will be suppressed and have no influence upon the final result.

Unfortunately, until the cider buildings at the Institute are completed, we cannot regulate the temperature of our fermenting room. During the season 1913–14 many of the juices to which were added pure yeast cultures had to be kept during the fermentation in an open shed exposed to irregular and sometimes very low temperatures. In the beginning of December, 1913, the temperature of the juices had fallen to 36–37° F., and consequently in most cases the pure yeast added was completely outgrown by the natural more cold-resisting yeast-types. In such cases the influence of the selected yeast

could not be traced, and the cider made showed no difference in aroma and flavour from the cider made from the same juice, but left to ferment naturally. Repeated microscopical examinations during the fermentation of the juices to which were added pure yeast showed that the yeast added was gradually more and more suppressed by the natural yeast-types, as the fermentation proceeded.

As regards the rate of fermentation, there was not much difference between the juices to which had been added pure yeast, and the corresponding juices left to ferment naturally. It would be expected that the juices fermented with pure yeast would show a quicker fermentation. This would certainly be the case, if convenient temperatures were maintained.

Amongst the single variety juices fermented with pure yeast, the best results were obtained with the Pull Court Red and Skyrme's Kernel, where some improvement in flavour could be observed. The first had been fermented with Yeast No. 11 (isolated from Wallis Red cider); the last with Yeast No. 8 (isolated from the French Romeril cider).

The Blends B, C and D, referred to in the following tables were fermented with different pure yeasts.

In the case of Blends C and D there was no noticeable difference in flavour or aroma between the casks to which pure yeast was added and the controls left to ferment naturally.

BLEND B.—A Mixture of Kingston Black, Large White, and Taylor's Bitter Juices.

			Date of Pressing.	Specific Gravity of Fresh Juice.	Malic Acid per cent.	Tannin per cent.	Present Specific Gravity.	Remarks.
*51	No. 1	Fermented with Yeast No. 21 (isolated from Newton Sweet Cider)	Nov. 21	1·057	·42	·19	1·028	Very good
*52	No. 2	Fermented with Yeast No. 9 (isolated from Sweet Alford Cider)	,,	,,	,,	,,	1·028	Good
*53	No. 3	Fermented with Yeast No. 13 (isolated from Gatcombe Cider)..	,,	,,	,,	,,	1·033	Very good
54	No. 4	Fermented with Yeast No. 19 (isolated from Strawberry Norman Cider) ..	,,	,,	,,	,,	1·029	Very good
55	No. 5	Fermented with Yeast No. 16 (isolated from Red Jersey Cider)	,,	,,	,,	,,	1·027	Good
56	No. 6	Fermented with Yeast No. 7 (isolated from Kingston Black Cider)	,,	,,	,,	,,	1·026	Good
57	No. 7	Fermented with Yeast No. 32 (isolated from Steinberg, a rhenish wine) ..	,,	,,	,,	,,	1·027	Good
*58	No. 8	Natural Fermentation	,,	,,	,,	,,	1·028	Good
59	No. 9	Natural Fermentation	,,	,,	,,	,,	1·029	Very good

All the Blend "B" Ciders were filtered on February 5th, 1914
* Casks treated inside with Paraffin Wax.

BLEND C.—Mixed Fruit.

		Date of Pressing.	Specific Gravity of Fresh Juice.	Malic Acid per cent.	Tannin per cent.	Present Specific Gravity.
60	No. 1 Natural Fermentation	Dec. 11	1·056	·37	·36	·1 033
61	No. 2 Fermented with Yeast No. 33 (isolated from Piesport, a rhenish wine) ..	,,	,,	,,	,,	1·036
62	No. 2 Fermented with Yeast No. 29 (isolated from Scharzhofberg, a rhenish wine)..	,,	,,	,,	,,	1·036

All the Blend "C" Ciders were filtered March 2nd, 1914.

BLEND D.—A Mixture of Dabinett, Large Green, and Masters' Jersey Juices.

		Date of Pressing.	Specific Gravity of Fresh Juice.	Malic Acid per cent.	Tannin per cent.	Present Specific Gravity.
64	No. 1 Natural Fermentation	Dec. 18	1·050	·26	·24	1·015
65	No. 2 Fermented with Yeast No. 26 (isolated from Kingston Black Cider)	,,	,,	,,	,,	1·016
66	No. 3 Fermented with Yeast No. 5 (isolated from Yellow Styre Cider)	,,	,,	,,	,,	1·015

All filtered February 23rd, 1914.

THE RELATIVE VALUE OF CANE AND BEET-SUGAR FOR FERMENTATION PURPOSES.

By Otto Grove.

The value of different cane-sugars and beet-sugars for sweetening cider were tested in a series of experiments, more especially to find out the difference between cane and beet-sugar as regards flavouring of cider.

The samples of cane-sugars used were the types commercially described as Standard 11, Standard 14, Standard 15, and a sample of raw cane-sugar. The beet-sugars used were the type called star granulated and a sample of raw beet-sugar. The sugars were kindly supplied by Mr. J. A. Sanders, Cotham Vale, Bristol.

The cider used for the sweetening experiments was the same in all cases, and consisted of a mixture of several dry ciders. It had a specific gravity of 1·008, and contained ·42 per cent. of acid.

The fermentations were carried out in 1 gallon bottles completely filled and furnished with a rubber-stopper with a fermenting trap of the pattern described above in the section dealing with acetification.

The sugar was in all cases dissolved in the same quantity of boiling water, and boiled for 15 minutes to sterilize the sugar syrup. It was then cooled and mixed with the cider. All the samples were kept under exactly similar conditions at the ordinary room temperature.

	Sp. gr. at start, 25 Mar., 1914.	Sp. gr., 8 July, 1914.	Sp. gr., 15 Dec., 1914.
1 Cider alone (control) ..	1·008	1·005 clear	1·005 clear
2 Cider+5% Cane-sugar St. 11	1·023	1·013 very cloudy	1·006 very cloudy
3 Cider+5% Do. St. 14	1·022	1·013 clear	1·013 very cloudy
4 Cider+5% Do. St. 15	1·022	1·013 very cloudy	1·013 very cloudy
5 Cider+5% Beet-sugar ..	1·022	1·012 clear	1·012 clear
6 Cider+10% Cane-sugar St. 11	1·031	1·027 clear	1·023 very cloudy
7 Cider+10% Do. St. 14	1·030	1·025 clear	1·025 clear
8 Cider+10% Do. St. 15	1·031	1·027 clear	1·023 very cloudy
9 Cider+10% Beet-sugar ..	1·031	1·025 clear	1·025 clear
10 Cider+6% raw Cane-sugar ..	1·027	1·014 clear	1·014 clear
11 Cider+6% raw Beet-sugar ..	1·026	1·009 clear	1·008 clear

There was not much difference between the different bottles as regards visible signs of fermentation. The 5 per cent. started fermentation a few days before the 10 per cents., and kept up a more rapid fermentation the whole way through, the decrease in specific gravity being 9–10 points, whereas the 10 per cents. only had lost 4–6 points, when fermentation stopped.

After about two months at room temperature the fermentation was apparently completely finished, only rarely a bubble of gas being observed to mount to the surface. On the 8th of July, after about three and a half months, the samples were filled in bottles to be kept for comparison of flavour. When bottled, all the samples were clear with a yeast-deposit, with exception of 2 and 4, which both were very cloudy and had a large sediment in addition to the yeast-deposit. This sediment consisted chiefly of matter precipitated from the cider and a bacterial growth, which was the cause of the precipitation taking place. The bacterium was a rather long, irregular rod-shaped organism, showing characteristic angular and zig-zag forms.

During the autumn this bacterial disease gradually turned up in all the samples sweetened with cane-sugar except 7 and 10, both of which kept clear.

When the ciders had been kept for a month in bottles, their aroma and flavour were compared, and this comparison was repeated several times during the autumn. As a result it must be said that, as far as these samples of sugars are concerned, the beet-sugars gave a better result than the cane-sugars. Leaving out of consideration that most of the samples sweetened with cane-sugar did not keep but were attacked by a bacterial disease, whereas all the beet-sugar samples remained in good condition, the flavour of the cane-sugar samples was in all cases inferior (except perhaps in the case of the raw-sugars, where no difference in flavour could be noted between the beet and cane-sugar samples). That is, the peculiar taste of cane-sugar was easily detected, whereas the beet-sugar did not give any new flavour to the cider, but simply acted as a neutral sweetener, which, of course, is preferable. This result, being somewhat contrary to previously accepted views in this country, needs further confirmation by fresh experiments before much importance can be attached to it.

THE BLACKENING OF CIDER.

By Otto Grove.

It is sometimes the case that cider which has been kept in bottles or casks, when poured out into a glass or otherwise exposed to the action of the air, in a short time—sometimes in 5 to 10 minutes—changes colour, assuming a greenish-black tinge.

The cause of this generally is that the apples or the juice during the making have been in touch with iron for some time. Through the action of the acids in the fruit iron is dissolved, which combines with the tannin in the juice. This iron-tannin compound is soluble without colour in ciders containing a fair amount of malic acid (·5 per cent. or more), but in ciders with less acid it gets quickly oxydised by the action of the air, into a dark coloured compound, which often is precipitated in the cider.

Two kinds of apples, the Red French and Broadleaved French, very common in Herefordshire, the ciders of which are especially liable to blackening, were supplied in the autumn of 1913 by Major Caddick, Ross, with the object of trying the influence of iron upon the juices. The apples were ground in a wooden mill, and care was taken that the juices did not get into touch with iron during the making. As ciders prepared by adding a certain amount of water to the pomace and repressing suffer very much from blackening some of the apples were dealt with in this way. To another lot of the juice tartaric acid was added so as to increase the acidity to ·5 per cent. To one sample of each juice a small piece of thin iron wire was added and allowed to remain in the juices during the first three days of the fermentation. It was then removed.

The analyses of the juices were :—

Red French :	Spec. Gravity 1·050,	Malic Acid, ·24 %,	Tannin ·19 %
Broadleaved French :	,, ,, 1·053,	,, ,, ·22 %,	,, ·31 %

All the fermentations were carried out in glass vessels at room temperature and allowed to proceed normally. Fermentation started quickly in all samples, the Red French juices showing a more rapid fermentation than those of the Broadleaved French. After five weeks fermentation had stopped, and all the samples were filtered and bottled.

The particulars of the individual samples tested were as follows :—

		Specific Gravity at start.	Specific Gravity when Bottled.
	Broadleaved French.		
1	Ordinary juice	1·053	1·033
2	Juice diluted with 10% water and added tartaric acid to increase acidity	1·045	1·016
3	Juice diluted with 20% of water	1·040	1·017
4	Juice diluted with water and small piece of iron wire added	1·043	1·015
	Red French.		
1	Ordinary juice	1·050	1·014
2	As 2 in above experiment	1·045	1·018
3	As 3 „ „	1·040	1·010
4	As 4 „ „	1·038	1·005

The bottled ciders were on several occasions tested as to their liability to discolouration when exposed to the air by being poured out into glasses, which were left for several days without cover. It was always found that the two Nos. 4 (treated with iron wire) very quickly assumed a greenish colour, which in the course of about 15 minutes went dark green, later changing to blackish-green, and giving a black deposit. On the contrary, all the other samples only slowly changed their colour from the original pale yellow into a darker yellow tinge, even when kept exposed to the air for several days.

It was consequently proved that the iron was the cause of the abnormal colouring, since none of the other samples, both diluted and undiluted, which had been kept out of touch with iron, showed more than the usual darkening of colour, which normally takes place with all ciders exposed to the air, and is caused by the oxidation of the tannin.

The iron gets into the juice from the iron mill, iron shovels, and other appliances of iron used in the making. It is also possible that soil adhering to the apples in some cases brings iron in the juice.

It is consequently essential only to use iron appliances when strictly necessary, and to clean them well before and after use. It is especially important that the juice and particles of pomace be removed when the milling is finished for the day, because otherwise the acid from the fruit mill dissolves some iron, which will get into the juice prepared the following day.

FERMENTATION EXPERIMENTS WITH PLUM JUICE.

By Otto Grove.

Some experiments were carried out during the autumn of 1914 to utilise plums for the making of a kind of plum wine and brandy, the object being to ascertain if in years of glut unmarketable fruit could be profitably dealt with in some way of that kind. The variety of plum used was the Pershore egg plum, of which large quantities are grown in Worcestershire. The samples were sent by Mr. G. F. Hooper, Pershore.

The juice of a sample was expressed for analysis, and it had a specific gravity of 1·040, contained 1·2 per cent. of acid (determined as malic acid), and 2·75 per cent. of sugar.* Small samples of the juice placed at 25°C. gave a rapid natural fermentation. In five days the specific gravity had fallen to 1·007, the fall in gravity being partially due to the coagulation of pectic matter (plant gum), which was present in the juice in large quantities. A microscopical examination after fermentation showed the presence of an elongated yeast in large numbers, the appearance of the yeast being very similar to that of many of the yeasts found in cider.

Some experiments on a larger scale were carried out :—

(1) About 70lbs. of plums were crushed without breaking the stones. The stones were removed, and the fruit pulp pressed after being packed in cloths in a small cider press. The small press available for the purpose was a hand-worked type, and it was very difficult to express the juice thoroughly, although the press was left for two days, increasing the pressure gradually as much as possible. The resulting juice was very thick and gelatinous and the quantity obtained only about 2 gallons ; with a stronger press more juice would, of course, be obtainable.

The expressed juice had a specific gravity of 1·045, and contained ·63 per cent. of acid. To it was added a culture of a wine-yeast (No. 37) ; and it was left to ferment at a temperature of about

* This is a very low percentage of sugar. Other samples contained a higher amount, probably the average content of sugar in the juice of well ripened fruit is about 5 per cent.

60° F. The fermentation started quickly, and the juice was nearly clear in a fortnight, when it was bottled. The specific gravity was 1·007. The resulting wine was very thin, but possessed a not unpleasant flavour and aroma.

(2) About 70lbs. of plums were crushed, without breaking the stones, and put into a small tub with 3 gallons of water and 5lbs. of sugar. The mixed juice had a specific gravity of 1·037, and contained ·4 per cent. of acid. Fermentation started quickly, and in the course of three days the gravity fell to 1·032. It was then strained through cloth, and the residue, after removal of the stones, was pressed. After a further ten days the fermentation stopped; and the juice, being nearly clear, was then bottled. The specific gravity had fallen to 1·001. The resulting wine was very similar to No. 1, but of a stronger plum flavour and aroma.

(3) The stones and press-cakes remaining from the above experiments were passed through a wooden mill, whereby most of the stones were broken. To the whole mass was added 5 gallons of water and 5lbs. of sugar. It was allowed to ferment for a fortnight. The liquid was then found to be completely fermented. It was filtered through a cloth and subjected to distillation in a small still of the same pattern as is used in France for distilling of brandy from cider. The plum spirit was distilled to a strength of about proof (about 57 volumes per cent. of alcohol), and had a very nice aroma reminiscent of cherry-brandy. The flavour was not particularly good, being somewhat like freshly distilled brandy; but it will probably greatly improve on keeping. If it could be kept in wood, it would certainly do so, but unfortunately the quantity at present available is too small for that purpose.

As these plums contain very little sugar, it will be necessary, if the method comes into practical use, to add sugar to the juice, or to add sugar and water as in 2. If the method in 2 is followed, the plum-wine will retain more of the plum character, because the aromatic elements of the fruit are better extracted if the fermentation is allowed to proceed for some time before pressing.

It is intended to repeat the above experiments on a larger scale during the coming season.

CIDER APPLE JELLY WITHOUT SUGAR.

By B. T. P. Barker and Otto Grove.

In view of the abundance of the cider fruit in 1914 and of the desirability of preventing waste of any material of food value during the war, the possibility of converting cider apples into jam or jelly was investigated in the laboratories at Long Ashton. It has been found possible to produce a very palatable jelly from suitable varieties without the addition of sugar or glucose. An attempt is being made to put the undertaking on a commercial footing and to obtain a market for the jelly.

The method is also applicable to domestic conditions, and a supply of home-made jelly can be simply and inexpensively made in districts where cider-apple juice is obtainable. Since the prices of jam and of sugar are likely to rule high for some time, particulars of the method by which a supply can be made very cheaply in the home will, doubtless, be of interest to consumers of jam.

The cider apples especially suitable for making this jelly are the sweet and bitter-sweet varieties. The sharp or sour varieties will, if used by themselves, give a jelly of too acid a flavour. They can however, be used if mixed in small quantities with the sweets and bitter-sweets.

The juice of the apple is alone required. It can be obtained from the cider press in the usual way, and should be used as fresh as possible, and in any case before fermentation has started. It is generally desirable to strain it through a jelly-bag or piece of muslin to remove particles of pomace or any other solid matter. The filtered juice is then concentrated by boiling in an open vessel over a fire or an oil stove. An enamelled saucepan serves the purpose very well; but iron saucepans are not advised, since the juice acquires a very dark colour, from contact with the iron. A double saucepan, such as a porridge saucepan, gives better results, but the concentration takes place more slowly. In any case it is desirable to use a double saucepan for the latter part of the concentration, since a lighter coloured jelly can be obtained in that way.

When the juice is reduced by boiling to about one-sixth of its original bulk, it is poured out into jars, where it will set as a rule to a firm jelly in the course of one or two days. Some juices occasionally require a longer time to set.

Many juices will make very good jelly in this simple way; but, in some cases, further treatment is necessary to make them set. This can be done by boiling up separately a further lot of juice with a small quantity of the freshly pressed pomace taken from the cider press, and adding the extracted juice from this mixture to the previously concentrated juice. The extract is made by mixing the pomace with the unboiled juice at the rate of about one small teacupful of pomace to one quart of juice. The mixture is cooked for about half an hour. This can be done in an enamelled saucepan over a fire, if constantly stirred to prevent the pomace from charring; or it can be treated in a double saucepan or in an oven in a stone jar. After the necessary cooking the juice is extracted by squeezing through a jelly-bag, or a piece of linen or calico, and is then added to the concentrated boiling juice which requires treatment. The boiling is then continued until the latter is again reduced to about one-sixth of the original volume taken. It is then poured into jars to set.

It is not possible to give exact quantities of the amount of extract from the boiled pomace required to make concentrated juice set to a jelly, since the conditions of ripeness of the apples and other factors affect the question; but, as a guide, it is suggested that the quantity of extract added should be about equal to that of the juice after concentration. Thus, if six gallons of juice were originally used, the quantity of extract to be added would be one gallon.

After the jelly has been poured into jars, it should be treated in the same way as an ordinary jam.

If it is desired to produce a very clear jelly, or if the juice is too bitter, it is recommended that a little gelatine should be added before straining and boiling. The gelatine must be dissolved in a little warm water before addition, and the quantity used should be about half-an-ounce to ten gallons of juice. The white of an egg mixed with a little cold water can be used in the place of gelatine, that from one egg being sufficient for one gallon of juice. After adding the white of egg, the juice must be boiled for about half an hour and then strained before boiling down.

Blackberry and other fruit jellies can also be made by this method by the addition of juices of those fruits to the apple juice before concentration.

Amongst others, the following varieties were tried for jelly-making:

Sweet varieties.—Morgan Sweet, Court Royal, Burstout, Dove, Sweet Alford, and Frogington Glory.

Bitter-sweet varieties.—Royal Jersey, Fillbarrel, Broadleaved French, Strawberry Norman, Brown Snout, Horner, and Buskin.

Sharp varieties.—Kingston Black, Cap of Liberty, and Lambrook Pippin.

Of the sweet varieties the Morgan Sweet gave the best jelly, being

quite clear, of a golden-yellow colour, very fine flavour, and setting very well, when the juice was boiled down to one-sixth of the original volume. The Sweet Alford, Burstout and Dove juices also gave a good jelly, but the flavour was not quite as good as was the case with Morgan Sweet. The colour was darker and the setting more difficult. With those varieties it was necessary to boil down to one-seventh of the original volume to make the jellies set without adding pomace extract. The results obtained with Court Royal and Frogington Glory did not come up to the above-mentioned, although a very palatable jelly was obtained. It was necessary to add pomace to make them set sufficiently.

In the case of the bitter-sweet varieties it was not as a general rule necessary, from the flavour point of view, to add gelatine to remove the tannin. This was only the case with the very bitter sorts, *e.g.*, Strawberry Norman, which contained ·42 per cent. of tannin. The best results were obtained with Fillbarrel, Royal Jersey and Buskin, which all gave a jelly of very good flavour but rather dark colour, and as was the case with most of the sweets, the setting was rather slow. It was necessary to add pomace-extract in many cases to obtain a jelly without boiling down too much (more than one seventh).

The sharp varieties also had to be boiled down to about one-seventh part of the original volume to make them set by themselves; and as that makes them much too acid to the average palate, it was found necessary to add pomace. The jellies were of a very good flavour and colour, but naturally very acid.

A number of juices from mixed apples were boiled down, and gave, in many cases, a very satisfactory result.

If, instead of boiling down to one-sixth, the concentration is stopped earlier, so that about one-fifth of the original volume is left, the concentrated juice will not set, but remain liquid as a syrup. This apple-syrup can be used with advantage to take the place of sugar-syrup when bottling fruit. As it keeps very well, it can be bottled and used, diluted with water, as a pleasant, non-alcoholic drink.

It is, of course, also possible to dilute the syrup with water and add some yeast and thus make it into cider at any moment.

By boiling down the juice completely and leaving to cool a hard toffee-like residue is formed, which is a kind of sweetmeat of a very pleasant, sweet, and brisk flavour.

Reckoning the value of cider apples at 30s. per ton, a price higher than the average in 1914, it is estimated that the home-made jelly could be made at a cost of less than 2s. per gallon.*

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* Separate copies of the foregoing particulars respecting Cider Apple Jelly can be obtained in the form of a leaflet from the National Fruit and Cider Institute.

THE COMPOSITION OF VINTAGE APPLE AND PEAR JUICES, 1914–15.

By B. T. P. Barker and Otto Grove.

As in previous seasons analyses of all the juices of the various samples of apples dealt with at the Institute during the cider-making season have been made. In the following tables, A and B, results of these analyses are given.

The results given in Table A are from varieties which were purchased for experimental purposes in the cider house or sent in by growers for examination. In addition, a certain number of varieties grown at the Institute are included, where the bulk was sufficient for cider-making on a practical scale.

In Table B are given the results of the analyses of the juices obtained from fruit grown on individual trees in the orchards and plantations at the Institute. As stated previously, these annual records of the results from individual trees are being made in order to determine the extent of variation from season to season, and the extent of the difference, if any, between individual trees of the same variety. All analyses are made when the fruit in each instance has reached what—so far as can be judged—is the optimum point of ripeness from the vintage point of view. In all cases where there are a number of samples of the same variety from different trees the analyses of those samples are made on the same day so that the results may be strictly comparable.

Taking the results as a whole, the season 1914–1915 has not shown any features of particular interest. The percentages of malic acid and tannin are, in the majority of cases, not very far removed from the normal for the variety concerned. The rates of fermentation have been somewhat variable in individual cases, but, as usual, the majority of early juices fermented comparatively rapidly, while the average rate of fermentation of the juices dealt with later in the season was considerably less. On the whole the rate was probably slightly higher than usual. The specific gravities were, for the most part, appreciably below the average. There are, however, some varieties which have given distinctly higher results than usual in this respect. Of the juices dealt with on a large scale for cider-

TABLE A.—ANALYSES OF APPLES AND PEARS, 1914–1915.

Name of Variety.	Specific Gravity of Juice.	Percentage Composition of Juice.			Rate of Fermentation.	Grower.	District.
		Total Sugar. Approximate.	Malic Acid.	Tannin.			
APPLES.							
BACKWELL RED	1·046	9—11	·62	·09	3·5	G. A. Horler ..	Backwell S.
BICKINGTON GREY	1·053	10·75—12·75	·95	·13	6·8	J. W. F. Bickford ..	Newton Abbott D.
BRICE'S KERNEL	1·043	8·25—10·25	·85	·14	9·5	T. Garland ..	Lydney G.
BROADLEAF JERSEY	1·050	10—12	·49	·16	3·7	Asylum (No. 18)	Hereford H.
BROWN SNOUT	1·052	10·5—12·5	·27	·30	5·0	G. Child	Nunnington H.
BURSTOUT	1·051	10·25—12·25	·16	·10	5·5	R. Allen	South Petherton S.
BUSKIN	1·057	11·75—13·75	·28	·21	6·1	S. H. Osborn ..	North Cadbury S.
BUTLEIGH No. 14	1·051	10·25—12·25	1·16	·35	3·2	Asylum (No. 14) ..	Hereford H.
BUTTER BOX	1·047	9·25—11·25	·64	·21	4·6	J. W. F. Bickford ..	Newton Abbot D.
CAP OF LIBERTY	1·048	9·5 —11·5	·63	·24	6·2	Cider Institute ..	Long Ashton S.
Ditto	1·066	14—16	·90	·26	7·1	D. Phelps	Tibberton G.
Ditto	1·050	10—12	·80	·21	2·5	Asylum (No. 15) ..	Hereford H.
Ditto	1·062	13—15	·71	·23	2·3	Berkeley Orchard ..	Berkeley G.
Ditto	1·046	9—11	·75	·20	2·1	J. H. Symes ..	Martock S.
Ditto	1·046	9—11	·85	·21	2·6	C. Porter	South Petherton S.
Ditto	1·055	11·25—13·25	·76	·26	5·0	J. Hawkins ..	Brockley S.
CHERRY NORMAN	1·059	12·25—14·25	·23	·31	5·4	Asylum (No. 4) ..	Hereford H.
CHERRY PEARMAIN	1·056	11·50—13·50	·57	·24	4·0	J. Helm	Weobley H.
CHISEL JERSEY	1·057	11·75—13·75	·16	·25	6·8	W. Mutton ..	Lydney G.
Ditto	1·072	15·5 —17·5	·20	·40	6·7	F. W. Crawshay ..	Hampnall, Norfolk
Ditto	1·058	12—14	·23	·35	5·5	C. Porter	South Petherton S.
Ditto	1·058	12—14	·19	·37	6·0	S. H. Osborn ..	North Cadbury S.
COLLEGE	1·050	10—12	·75	·20	3·3	G. Child	Nunnington H.
COURT ROYAL	1·045	8·75—10·75	·23	·10	11·2	Cider Institute ..	Long Ashton S.
Ditto	1·054	11—13	·17	·14	4·8	Asylum (No. 17) ..	Hereford H.

COWARNE RED	1·059	12·25—14·25	·61	·19	4·5	D. Phelps	Tibberton	G.
Ditto	1·053	10·75 12·75	·66	·21	3·6	Asylum (No. 22) ..	Hereford	H.
CREMIÈRE	1·055	11·25 13·25	·21	·17	8·3	J. Watts	Backwell	S.
Ditto	1·041	7·75 9·75	·18	·13	8·2	W. Mutton ..	Lydney	G.
DABINETT..	1·056	11·5 —13·5	·21	·22	4·3	C. Porter	South Petherton	S.
Ditto	1·058	12 14	·12	·24	5·2	Ditto	Ditto	
Ditto	1·055	11·25—13·25	·15	·28	7·8	Cider Institute ..	Long Ashton	S.
Ditto	1·061	12·75—14·75	·11	·37	5·1	Asylum (No. 10) ..	Hereford	H.
DOUX AMER	1·045	8·75—10·75	·12	·16	6·0	W. Mutton ..	Lydney	G.
DOVE	1·048	9·5 —11·5	·20	·18	6·0	S. H. Osborn ..	North Cadbury	S.
DUFFLIN	1·060	12·5 —14·5	·80	·18	3·1	J. C. Daubuz ..	Killiow, Truro,	C.
DYMOCK RED	1·053	10·75—12·75	·31	·09	6·8	W. Mutton ..	Lydney	G.
Ditto	1·059	12·25—14·25	·32	·22	6·1	Asylum (No. 6) ..	Hereford	H.
EGGLETON STYRE	1·069	14·75—16·75	·36	·23	5·4	A. E. Hill	Ledbury	H.
Ditto	1·055	11·25—13·25	·22	·26	5·2	Asylum (No. 19) ..	Hereford	H.
Ditto	–	—	·16	·42	–	F. W. Crawshay ..	Hempnall, Norfolk	
FAIR MAID OF DEVON ..	1·052	10·5 —12·5	·79	·12	4·8	Asylum (No. 13) ..	Hereford	H.
FILL BARREL	1·058	12—14	·20	·34	5·3	S. H. Osborn ..	North Cadbury	S.
FOXWHELP	1·050	10— 12	·76	·27	5·2	H. A. Wadworth ..	Breinton Court, Hereford	H.
Ditto	–	—	·54	·19	—	W. Mutton ..	Lydney	G.
FRÉQUIN AUDIÈVRE	1·058	12—14	·22	·29	7·2	J. C. Daubuz ..	Killiow, Truro,	C.
FRÉQUIN DE CHARTRES ..	1·049	9·75—11·75	·34	·17	7·8	J. Hawkins ..	Brockley	S.
FROGINTON GLORY	1·054	11—13	·25	·19	5·0	S. H. Osborn ..	North Cadbury	S.
GALLIARDIOT	1·045	8·75—10·75	·83	·14	4·0	J. Hawkins ..	Brockley	S.
GEORGE JAMES	1·045	8·75—10·75	·18	·21	5·6	S. H. Osborn ..	North Cadbury	S.
HARRY MASTERS	1·059	12·25—14·25	·22	·27	7·0	Ditto ..	Ditto	
HAWKINS KERNEL	1·048	9·5 —11·5	·47	·20	3·7	T. Garland	Lydney	G.
Ditto	1·049	9·75—11·75	·38	·15	5·0	Ditto	Ditto	
HORNER	1·056	11·5 —13·5	·14	·32	4·2	C. Porter	South Petherton	S.
IMPROVED POUND	1·052	10·5 —12·5	·18	·13	3·4	Asylum (No. 24) ..	Hereford	H.
Ditto	–	—	·23	·13	—	Berkeley Orchard ..	Berkeley	G.
KILLERTON SWEET	—	—	·44	·35	—	F. W. Crawshay ..	Hempnall, Norfolk	
Ditto	1·060	12·5 —14·5	·65	·17	5·4	Asylum (No. 1) ..	Hereford	H.
Ditto	—	—	·40	·12	—	Berkeley Orchard ..	Berkeley	G.
KINGSTON BLACK	1·052	10·5 —12·5	·47	·19	2·9	J. H. Symes ..	Martock	S.

Name of Variety.	Specific Gravity of Juice.	Percentage Composition of Juice.			Rate of Fermentation.	Grower.	District.
		Total Sugar. Approximate.	Malic Acid.	Tannin.			
APPLES—*continued.*							
KINGSTON BLACK	1·053	10·75—12·75	·44	·17	4·0	T. Agnew May ..	Staplegrove S.
Ditto	1·071	15·25—17·25	·42	·19	—	F. W. Crawshay ..	Hempnall, Norfolk
Ditto	1·070	15—17	·56	·26	5·3	Asylum (No. 2) ..	Hereford H.
Ditto	1·076	16·5 —18·5	·40	·16	—	Berkeley Orchard ..	Berkeley G.
Ditto	1·051	10·25—12·25	·43	·15	5·0	S. Creed	White Lackington S.
Ditto	1·053	10·75—12·75	·47	·17	4·2		Tintinhull S.
Ditto	1·055	11·25—13·25	·55	·24	4·4	H. A. Wadworth ..	Breinton Ct., Hereford
Ditto	1·050	10—12	·45	·15	5·1	F. R. Willcox ..	Oldbury G.
Ditto	1·055	11·25—13·25	·41	·15	4·3		Norton Fitzwarren S.
Ditto	1·061	12·75—14·75	·45	·19	5·5	J. Hawkins ..	Brockley S.
Ditto	1·060	12·5 —14·5	·50	·16	4·5		Marden H.
Ditto (Improved)	1·058	12—14	·45	·25	4·3	Asylum (No. 3) ..	Hereford H.
KNOTTED KERNEL	1·055	11·25—13·25	·22	·49	4·5	J. Helme	Weobley H.
Ditto	1·058	12—14	·24	·25	4·3	W. Mutton	Lydney G.
Ditto	1·074	16—18	·20	·35	—	F. W. Crawshay ..	Hempnall, Norfolk
LAMBROOK PIPPIN	1·046	9—11	·59	·18	2·2	C. Porter	South Petherton S.
MEDAILLE D'OR	1·056	11·5 —13·5	·22	·85	6·8	Harper-Adams Coll.	Newport, Salop
Ditto	1·051	10·25—12·25	·24	·47	8·7	Cider Institute ..	Long Ashton S.
Ditto	1·051	10·25—12·25	·21	·43	4·1	J. C. Daubuz ..	Killiow, Truro C.
Ditto	1·075	16·25—18·25	·15	·57	7·2	D. Phelps	Tibberton G.
Ditto	1·069	14·75—16·75	·20	·66	5·6	Asylum (No. 21) ..	Hereford H.
MUSCADET	1·057	11·75—13·75	·30	·23	8·6	J. Hawkins ..	Brockley S.
NEVER BLIGHT	1·049	9·75—11·75	·52	·21	7·5	Harper-Adams Coll.	Newport, Salop
Ditto	1·052	10·5 —12·5	·68	·16	4·2	W. Mutton ..	Lydney G.
NEWTON JERSEY	1·047	9·25—11·25	·27	·28	3·3	A. E. Ellis	Newton St. Cyres D.
NOIR DE VITRY	1·047	9·25—11·25	·26	·17	7·3	J. Hawkins ..	Brockley S.
OLD FOXWHEPL	1·061	12·75—14·75	·95	·41	1·8	G. Child	Munnington H.

PAGE'S YELLOW	1·049	9·75- 11·75	·64	·12	6·0	T. Garland	Lydney	G.
PASSE REINE DE POMME	1·066	14 16	·26	·53	4·0	J. Hawkins	Brockley	S.
POPLE'S GUTTER	1·050	10 12	·83	·27	5·1	G. Horler	Backwell	S.
PORTER'S PERFECTION	1·059	10—12	·60	·25	2·7	C. Porter	South Petherton	S.
RED STREAK	1·051	10·25- 12·25	·75	·17	4·1	A. E. Hill	Ledbury	H.
Ditto	1·050	10 12	·09	·24	6·2	Asylum (No. 8)	Hereford	H.
Ditto	1·043	8·25 —10·25	·51	·15	—	Asylum (No. 9)	Hereford	H.
RED MANSE	1·045	8·75 10·75	·38	·21	4·1	C. Porter	South Petherton	S.
RED WORTHY	1·055	11·25- 13·25	·18	·16	6·1	Ditto	Ditto	
ROUGE BRUYÈRE	1·051	10·25- 12·25	·24	·19	9·4	J. Hawkins	Brockley	S.
ROUGE DE TRÈVES	1·045	8·75 10·75	·77	·15	5·5	Ditto	Ditto	
ROUGE LATOUR	1·065	13·75 15·75	·38	·19	6·1	Ditto	Ditto	
ROYAL JERSEY	1·048	9·5 —11·5	·27	·27	5·0	J. H. Symes	Martock	S.
Ditto	—	—	·20	·58	—	Berkeley Orchard	Berkeley	G.
Ditto	1·060	12·5 - 14·5	·17	·35	6·7	S. H. Osborn	North Cadbury	S.
SANDFORD JERSEY	1·061	12·75—14·75	·22	·26	4·0	F. W. Crawshay	Hempnall, Norfolk	
SEEDLING	1·050	10—12	1·36	·29	6·7	Cider Institute	Long Ashton	S.
SEEDLING	1·053	10·75—12·75	·22	·27	6·3	E. W Caddick	Ross	H.
SEEDLING	1·040	7·5 — 9·5	·50	·06	3·6	P. Collins	H. Welland, Malvern	
SEEDLING	1·048	9·5 —11·5	·65	·07	3·8	W. Mutton	Lydney	G.
SEEDLING	1·045	8·75—10·75	·46	·25	3·6	Asylum (No. 23)	Hereford	H.
SKYRME'S KERNEL	1·050	10—12	·22	·16	4·2	E. T. Loram	Alphington	D.
SLACK MA GIRDLE	1·047	9·25—11·25	·29	·15	4·3	J. W. F. Bickford	Newton Abbot	D.
Ditto	1·058	12—14	·21	·16	6·3	E. T. Loram	Alphington	D.
SPOTTED WHITE	1·057	11·75—13·75	·34	·45	4·3	J. Helme	Weobley	H.
STRAWBERRY NORMAN	1·063	13·25—15·25	·26	·50	6·1	D. Phelps	Tibberton	G.
Ditto	1·061	12·75—14·75	·37	·46	5·0	Asylum (No. 16)	Hereford	H.
Ditto	1·050	10—12	·40	·42	5·2	Cider Institute	Long Ashton	S.
Ditto	1·050	10—12	·17	·20	5·2	E. T. Loram	Alphington	D.
SWEET ALFORD	1·055	11·25—13·25	·25	·15	4·3	Asylum (No. 20)	Hereford	H.
Ditto	1·068	14·5 —16·5	·24	·20	5·6	D. Phelps	Tibberton	G.
Ditto	—	—	·17	·14	—	Berkeley Orchard	Berkeley	G.
Ditto	1·072	15·5 —17·5	·15	·33	8·2	F. W. Crawshay	Hempnall, Norfolk	
Ditto	1·049	9·75—11·75	·20	·13	6·3	W. Mutton	Lydney	G.
SWEET COPPIN	1·054	11—13	·16	·18	—	Asylum (No. 12)	Hereford	H.
Ditto	1·048	9·5 —11·5	·27	·38	6·3	J. Hawkins	Brockley	S.
TARDIVE FORESTIER								

Name of Variety.	Specific Gravity of Juice.	Percentage Composition of Juice.			Rate of Fermentation	Grower.	District.	
		Total Sugar. Approximate.	Malic Acid.	Tannin.				
APPLES—*continued.*								
TEIGN HARVEY	1·046	9—11	·58	·31	3·2	J. W. F. Bickford ..	Newton Abbot	D.
TWISTBODY JERSEY	1·056	11·5 —13·5	·18	·24	6·0	S. H. Osborn ..	North Cadbury	S.
Ditto	1·05.	12·25—14·25	·20	·43	5·8	J. H. Symes ..	Martock	S.
WHITE JERSEY	1·055	11·25—13·25	·27	·27	3·7	S. H. Osborn ..	North Cadbury	S.
WHITE NORMAN	1·047	9·25—11·25	·19	·35	4·5	J. Helme	Weobley	H.
YARLINGTON MILL	1·048	9·5 —11·5	·19	·16	4·8	W. Mutton ..	Lydney	G.
Ditto	1·054	11—13	·25	·30	4·7	Asylum (No 5) ..	Hereford	H.
Ditto	1·043	8·25—10·25	·19	·21	5·0	S. H. Osborn ..	North Cadbury	S.
YELLOW STYRE	1·060	12·5 —14·5	·62	·25	5·5	T. Garland ..	Lydney	G·
No. 32 (ASHTON)..	1·062	13—15	·15	·40	—	Asylum (No. 7) ..	Hereford	H.
PEARS.								
BUTT	1·061	12·75—14·75	·74	·26	3·2	A. E. Hill	Ledbury	H.
OLDFIELD	1·048	9·5 —11·5	·93	·05	3·1	G. E. Lloyd-Baker..	Hardwicke	H.
Ditto	1·057	11·75—13·75	·59	·47	1·6	A. E. Hill	Ledbury	H.
Ditto	1·057	11·75—13·75	·59	·12	4·7	James Davies ..	Marden	H.
Ditto	1·054	11—13	·61	·09	3·1	H. J. Phelps ..	Tibberton	G.
RED PEAR	1·051	10·25—12·25	·28	·16	5·1	A. E. Hill	Ledbury	H.

TABLE B.

COMPOSITION OF JUICES FROM YOUNG ORCHARD TREES & TREES ON PARADISE STOCK.

Name of Variety.	Number of Tree.	Composition of Juice, 1914. Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 deg. C.
APPLES.					
Bramtôt (on Paradise stock)	119	1·050	·55	·20	8·1
Ditto (ditto)	120	1·052	·55	·16	7·4
Ditto (ditto)	121	1·050	·47	·13	9·5
Broadleaf Jersey	1	1·053	·20	·35	8
Ditto	2	—	·25	·55	—
Ditto	3	1·058	·24	·50	—
Ditto	4	1·051	·23	·35	7·6
Ditto	5	1·051	·22	·41	8
Broadleaf Norman	1	1·047	·18	·23	3·6
Ditto	2	1·047	·20	·23	4·6
Ditto	3	1·046	·20	·26	2·6
Ditto	4	1·047	·18	·25	7·3
Ditto	5	1·053	·26	·40	3·6
Ditto	6	1·050	·20	·28	3·5
Ditto	7	1·045	·16	·23	8·5
Ditto (on Paradise stock) ..	64	1·050	·09	·22	7·3
Ditto (ditto)	65	1·046	·09	·21	8·5
Ditto (ditto)	66	1·045	·07	·20	4·8
Ditto (ditto)	67	1·047	·09	·20	9·4
Ditto (ditto)	68	1·047	·07	·20	8·8
Ditto (ditto)	71	1·046	·09	·19	9·2
Ditto (ditto)	82	1·046	·16	·21	6
Ditto (ditto)	83	1·045	·16	·23	6·6
Ditto (ditto)	84	1·054	·20	·34	5
Brown Jersey (on Paradise stock) ..	72	1·046	·11	·18	9·3
Ditto (ditto)	73	1·045	·10	·15	6·6
Ditto (ditto)	74	1·049	·11	·19	7·8
Ditto (ditto)	76	1·051	·08	·25	6·5
Ditto (ditto)	78	1·052	·08	·22	5·3
Brown Thorn (on Paradise stock) ..	158	1·053	·13	·28	10·6
Ditto (ditto)	159	1·054	·12	·31	7·8
Butleigh No. 18 (Nursery)		1·050	·52	·19	10
Ditto *No.* 14 (on Paradise stock)	111	1·043	·29	·10	7
Cap of Liberty (head-grafted on Morgan Sweet, 1905)	1	1·046	·82	·23	6·1
Ditto (ditto, 1906)	3	1·044	·87	·21	6·1
Ditto (ditto)	4	1·045	·92	·24	7
Ditto (ditto)	5	1·043	·82	·20	5·8
Ditto (ditto)	6	1·040	·61	·14	8·2
Ditto (ditto)	7	1·044	·72	·15	10
Ditto (ditto)	8	1·048	·88	·21	3·4
Ditto (ditto)	9	1·047	·96	·33	4·8
Ditto (ditto)	10	1·039	·63	·16	15
Ditto (head-grafted on Broadleaf Jersey, 1906)	180	1·045	·77	·19	4·6
Ditto (ditto, ditto)	181	1·042	·86	·20	8·2
Ditto (on Paradise stock) ..	252	1·042	·37	·12	13·5
Ditto (ditto)	253	1·040	·42	·12	10

TABLE B—*continued.*

Name of Variety.	Number of Tree.	Composition of Juice, 1914.			
		Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 deg. C.
APPLES—*continued.*					
Cherry Norman	1	1·046	·16	·35	4·3
Ditto	2	1·407	·15	·45	3·8
Ditto	3	1·046	·14	·48	6·3
Ditto	4	1·048	·16	·45	4·7
Ditto	5	1·043	·16	·45	4·8
Ditto	6	1·043	·16	·45	4·8
Ditto	7	1·046	·15	·45	5·3
Ditto	8	1·049	·17	·53	4·2
Ditto	9	1·042	·15	·35	5·1
Ditto	10	1·044	·16	·38	5·8
Ditto (on Paradise stock) ..	15	1·040	·16	·24	6·2
Ditto (ditto)	16	1·042	·14	·31	7·7
Ditto (ditto)	17	1·045	·15	·32	7·1
Ditto (ditto)	172	1·040	·11	·27	8
Ditto (vignons) (on Paradise stock)	512	1·040	·12	·30	9
Ditto (ditto) (ditto)	513	1·038	·13	·29	9·5
Ditto (ditto) (ditto)	514	1·037	·10	·33	9
Ditto (ditto) (ditto)	515	1·037	·06	·38	6·5
Cherry Pearmain (on Paradise stock)	210	1·046	·42	·20	7·6
Ditto (ditto)	211	1·045	·51	·17	8·5
Ditto (ditto)	213	1·042	·42	·18	10·2
Ditto (ditto)	214	1·048	·39	·23	12
Ditto (ditto)	215	1·048	·35	·22	—
Chevalier (on Paradise stock) ..	131	1·050	·12	·44	12·5
Ditto (ditto)	132	1·044	·08	·26	11
Ditto (ditto)	133	1·055	·10	·25	—
Ditto (ditto)	134	—	·09	·24	—
Chiffers (ditto)	490	1·054	·06	·15	12·5
Chisel Jersey	1	1·048	·15	·28	6·3
Ditto	3	1·061	·27	·82	4·8
Ditto	4	1·052	·18	·32	5·5
Ditto	5	1·052	·17	·30	5·1
Court Royal	1	1·040	·15	·11	9·7
Ditto	2	1·045	·14	·13	10
Ditto	3	1·046	·13	·11	8·7
Ditto	4	1·046	·12	·09	9
Ditto	5	1·047	·15	·10	7
Cowarne Red	1	1·043	·60	·18	5
Ditto	2	1·042	·53	·15	7·4
Ditto	3	1·041	·57	·18	7·4
Ditto	6	1·038	·52	·17	7
Ditto	7	1·040	·54	·17	7·6
Ditto	8	1·040	·55	·18	—
Ditto	9	1·041	·51	·17	6·6
Ditto (on Paradise stock) ..	60	1·043	·35	·16	8·6
Ditto (ditto)	272	1·039	·27	·15	—
Ditto (ditto)	273	1·045	·33	·12	—
Ditto (ditto)	274	1·044	·30	·13	—
Ditto (ditto)	275	—	·23	·12	—
Cremière (head-grafted on Warner's King, 1905)	67	1·040	·16	·13	8

TABLE B—*continued.*

Name of Variety.	Number of Tree.	Composition of Juice, 1914.			
		Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 deg. C.
APPLES—*continued.*					
*Crem*ière (on Paradise stock)	429	1·037	·08	·10	9·2
Ditto (ditto)	430	1·044	·07	10	8
Ditto (ditto)	431	1·042	·08	·10	8·5
Ditto (ditto)	432	1·042	·08	·11	8
Ditto (ditto)	433	1·040	·07	·13	8·2
Ditto (ditto)	434	1·040	·08	·10	7·7
Ditto (ditto)	436	1·039	·08	·11	7·2
Doux Amer (head-grafted on Broad-leaf Jersey, 1905)..	77	1·051	·22	·21	8·1
Ditto (on Paradise stock) ..	359	1·046	·13	·17	
Ditto (ditto)	361	1·041	·10	·15	10·2
Ditto (ditto)	362	1·037	·13	·16	9·2
Ditto (ditto)	363	1·038	·10	·12	—
Ditto (ditto)	364	1·040	·10	·13	10
Ditto (ditto)	365	1·042	·10	·17	10·5
Dove (on Paradise stock)	366	1·040	·07	·14	6·7
Ditto (ditto)	367	1·042	·07	·12	9·7
Ditto (ditto)	368	1·042	·08	·14	5·8
Ditto (ditto)	369	1·042	·13	·12	9·2
Ditto (ditto)	370	1·041	·12	·13	7
Ditto (ditto)	371	1·045	·11	·13	9·2
Ditto (ditto)	372	1·042	·14	·12	7·5
Ditto (ditto)	373	1·041	·15	·15	9·7
Dymock Red	1	1·050	·29	·12	11·5
Ditto	2	1·051	·30	·12	7·8
Ditto	3	1·048	·29	·12	—
Ditto	5	1·048	·30	·11	—
Ditto (on Paradise stock) ..	229	1·042	·23	·10	14·5
Ditto (ditto)	230	1·045	·18	·13	11·2
Ditto (ditto)	231	1·040	·16	·11	13·5
Écarlatine (head-grafted on Warner's King, 1906)	70	1·050	·21	·26	5·1
Ditto (ditto)	71	1·053	·20	·24	8·5
Ditto (ditto)	69	1·050	·10	·06	5·3
Ditto (on Paradise stock) ..	493	1·055	·08	·19	13·7
Ditto (ditto)	—	1·048	·05	·15	9
Ditto (ditto)	—	1·049	·05	·15	9·7
Ditto (ditto)	—	1·048	·05	·14	7
Ditto (ditto)	—	1·049	·04	·10	10·5
Eggleton Styre	1	1·054	·19	·12	—
Ditto	2	1·052	·17	·13	—
Ditto	3	1·050	·16	·12	6·2
Ditto	4	1·046	·18	·11	—
Ditto	5	1·048	·16	·11	6·8
Ditto	10	—	·15	·11	—
Ditto	233	1·055	·15	·12	7·1
Ditto (on Paradise stock) ..	220	—	·07	·12	
Ditto (ditto)	221	1·050	·08	·11	
Ditto (ditto)	222	—	·07	·10	
Ditto (ditto)	223	1·047	·05	·11	
Ditto (ditto)	224	—	·05	·13	—
Ditto (ditto)	228	1·050	·07	·11	—

TABLE B—*continued.*

Name of Variety.	Number of Tree.	Composition of Juice, 1914.			
		Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 deg. C.
APPLES—*continued.*					
Egglton Styre (on Paradise stock) ..	257	1·047	·10	·15	8·6
Fair Maid of Devon (on Paradise stock)	331	1·056	·82	·19	12·2
Footlands II. (on Paradise stock) ..	105	1·046	·21	·18	8·4
Ditto (ditto)	106	1·046	·16	·12	7·2
Foxwhelp (on Paradise stock) ..	151	1·040	·34	·27	10
Fréquin Audièvre (head-grafted on Broadleaf Jersey, 1906)	78	1·047	·09	·38	5·8
Ditto (ditto)	79	1·058	·16	·53	5·7
Ditto (on Paradise stock) ..	4	—	·15	·32	—
Ditto (ditto)	5	1·053	·08	·37	9·7
Ditto (ditto)	6	1·050	·06	·38	10
Ditto (ditto)	7	1·052	·04	·36	10
Ditto (ditto)	9	1·050	·04	·36	—
Ditto (ditto)	10	1·048	·05	·36	8
Ditto (ditto)	11	1·050	·04	·37	8·5
Ditto (ditto)	85	1·052	·08	·33	4·3
Ditto (ditto)	87	1·052	·09	·27	7·8
Ditto (ditto)	88	1·049	·11	·26	7·3
Fréquin Rouge (on Paradise stock) ..	420	1·048	·18	·28	11
Ditto (ditto)	422	1·041	·15	·27	10
Ditto (ditto)	423	1·046	·21	·36	—
Ditto (ditto)	424	1·044	18	·41	—
Ditto (ditto)	425	1·039	·20	·24	9·2
Ditto (ditto)	426	1·040	13	·20	10
Ditto (ditto)	427	1·040	·10	·26	10
Hardwicke (on Paradise stock)	469	1·048	·10	·17	9·7
Ditto (ditto)	470	1·046	·08	·16	8
Ditto (ditto)	471	1·048	·05	·16	8
Ditto (ditto)	473	1·049	·05	·17	8·1
Harry Masters (head-grafted on Warners King, 1906)	111	1·048	·13	·25	5·8
Ditto (ditto, ditto)	112	1·051	·16	·22	7·1
Ditto (ditto, ditto)	113	1·051	·14	·24	5·7
Ditto (ditto, 1909)	114	1·051	·13	·25	5·4
Ditto (ditto, 1906)	115	1·050	·13	·22	4·5
Jarrow Bank (on Paradise stock) ..	374	1·043	·23	·09	9·7
Kingston Black	2	1·055	·54	·30	4·4
Ditto	3	1·048	·45	·19	7·8
Ditto	4	1·052	·51	·34	9·2
Ditto	5	1·053	·44	·29	9
Ditto (head-grafted on Broadleaf Jersey, 1906)	179	1·046	·48	·29	6·8
Ditto (head-grafted on Bramley's Seedling, 1907)	218	1·054	·63	·25	7·2
Ditto (ditto)	219	1·055	·77	·27	5·1
Ditto (ditto)	220	—	·50	·30	—
Ditto (ditto)	221	1·058	·55	·28	6·4
Ditto (ditto on Blenheim Orange, 1907)	222	1·053	·58	·25	6·8
Ditto (ditto on Wooton's Crab)	223	1·055	·60	·23	5·4
Ditto (on Wootton's Crab, Nursery)	—	1·055	·64	·21	6·2
Ditto (on Paradise stock) ..	254	—	·17	·13	—

TABLE B—*continued.*

Name of Variety.	Number of Tree.	Composition of Juice, 1914.			
		Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 deg.C.
APPLES—*continued.*					
Kingston Black (on Paradise stock) ..	256	1·070	·21	·19	14
Ditto Improved (on Paradise stock)	260	1·053	·24	·31	7·7
Ditto, ditto (ditto)..	262	1·048	·23	·23	8·5
Ditto, ditto (ditto)..	265	1·049	·32	·24	9
Ditto, ditto (ditto)..	267	1·051	·25	·24	—
Ditto, ditto (ditto)..	268	1·046	·25	·21	—
Knotted Kernel	1	1·051	·17	·47	4·7
Ditto	2	1·052	·16	·36	4·8
Ditto	3	1·053	·13	·42	3·2
Ditto	4	1·053	·15	·43	3·2
Ditto	5	1·053	·12	·36	3·2
Ditto	6	1·054	·16	·40	3·4
Ditto	7	1·052	·14	·37	3·8
Ditto	8	1·052	·15	·33	6·1
Ditto	9	1·053	·16	·41	3·6
Ditto	10	1·053	·11	·39	3·5
Ditto (on Paradise stock) ..	25	1·050	·06	·19	8
Ditto (ditto)	29	1·052	·05	·19	—
Ditto (on Sandford Jersey) ..	128	—	·08	·28	—
Maggs' Seedling (on Paradise stock) ..	516	1·045	·27	·11	9·7
Ditto (ditto)	517	1·045	·31	·09	7·5
Major (on Paradise stock)	167	1·048	·13	·28	—
Ditto (ditto)	168	1·047	·11	·23	11·7
Médaille d'Or	1	1·060	·19	·49	5
Ditto	2	1·048	·18	·40	4·1
Ditto	3	1·054	·20	·44	8·1
Ditto	4	1·060	·21	·48	7·8
Ditto	5	1·059	·23	·46	7·3
Ditto	6	1·050	·17	·41	4·3
Ditto	7	1·057	·19	·41	10·7
Ditto	8	1·051	·16	·38	4·3
Ditto	9	1·058	·22	·47	10·5
Ditto	10	1·060	·23	·40	12·5
Ditto (head-grafted on Broadleaf Jersey, 1906)	183	1·064	·20	·50	12·7
Ditto (on Paradise stock) ..	55	1·060	·16	·48	8·3
Ditto (ditto)	56	1·053	·14	·46	6·5
Ditto (ditto)	58	1·064	·15	·53	6·2
Ditto (ditto)	59	1·073	·15	·69	9·5
Ditto (ditto)	62	1·072	·12	·78	5·2
Ditto (ditto)	63	1·073	·12	·75	5·1
M. Jacques (head-grafted on Morgan Sweet, 1905)	65	1·053	·26	·63	6
M. Jacques No. 1 (on Paradise stock ..	184	1·062	·12	·25	6·1
Ditto (ditto)	185	1·050	·07	·15	7·1
Ditto (ditto)	186	1·049	·08	·13	9·7
Ditto (ditto)	187	1·060	·07	·17	8·4
M. Jacques No. 2 (on Paradise stock) ..	199	1·052	·17	·60	10·2
Ditto (ditto)	200	1·050	·14	·56	6·1
Ditto (ditto)	201	1·050	·17	·61	5·8
Ditto (ditto)	203	1·048	·14	·48	5·8
Ditto (ditto)	204	1·047	·12	·44	7·7

TABLE B—*continued.*

Name of Variety.	Number of Tree.	Composition of Juice, 1914.			
		Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 Deg. C.
APPLES—*continued.*					
M. Jacques, No. 2 (on Paradise stock)	206	1·053	·20	·44	9·7
Ditto (ditto)	207	1·049	·25	·55	9
Neverblight (head-grafted on Hardwicks, 1905)	1	1·053	·78	·25	4
Ditto (ditto, ditto)	2	1·049	·70	·22	2·6
Ditto (ditto, 1906)	3	1·046	·58	·17	3
Ditto (ditto, ditto)	4	1·042	·45	·18	6
Ditto (on Paradise stock) ..	233	1·037	·10	·17	7·4
Ditto (ditto)	234	1·047	·22	·18	6·8
Ditto (ditto)	235	1·042	·21	·16	7·2
Ditto (ditto)	237	1·048	·25	·21	9·2
Ditto (ditto)	238	1·040	·33	·16	—
North Wood (on Paradise stock) ..	334	1·045	·12	·25	10·2
Ditto (ditto)	336	1·052	·13	·24	12
Osborne's Cadbury (Nursery)		1·057	·13	·45	8
Philip Norman (on Paradise stock) ..	376	1·040	·08	·15	6·5
Ditto (ditto)	377	—	·06	·27	—
Ditto (ditto)	378	1·041	·09	·21	8
Ditto (ditto)	379	1·042	·12	·16	5·7
Pytheres (on Paradise stock)	107	—	·18	·17	—
Ditto (ditto)	108	—	·19	·18	—
Red Foxwhelp (on Paradise stock) ..	26	1·056	·42	·17	13·3
Ditto (ditto)	27	1·056	·25	·15	10·4
Ditto (ditto)	216	1·052	·41	·14	12
Ditto (ditto)	218	1·047	·44	·13	10·7
Ditto (ditto)	219	1·052	·63	·14	10
Ditto (ditto)	531	1·048	·59	·12	16
Reinette Obry (head-grafted on Morgan Sweet, 1905)	1	1·044	·38	·13	6·6
Ditto (ditto)	2	1·048	·51	·14	6·8
Ditto (ditto)	3	1·040	·50	·11	5·8
Ditto (on Paradise stock) ..	306	1·043	·37	·10	10·7
Ditto (ditto)	307	1·044	·35	·08	11
Ditto (ditto)	308	1·042	·40	·09	10·5
Ditto (ditto)	310	1·040	·41	·10	10
Rouge de Trèves (head-grafted on Hardwicks, 1905)	72	1·052	·83	·14	8
Ditto (ditto)	73	1·046	·82	·12	9·3
Roussie (on Paradise stock)	483	1·076	·16	1·52	11·3
Ditto (ditto)	484	1·053	·13	·52	8·5
Royal Jersey (head-grafted on Bramley's Seedling, 1906)	149	1·053	·17	·42	5
Ditto (ditto)	150	1·047	·11	·33	6·6
Ditto (ditto on Broadleaf Jersey, 1906)	185	1·051	·13	·36	8·5
Ditto (on Paradise stock) ..	241	1·063	·18	·36	14·2
Sandford Jersey (on Paradise stock) ..	125	1·045	·10	·25	9·2
Skyrme's Kernel	7	1·050	·50	·28	6·8
Ditto	8	1·045	·49	·23	6·6
Ditto	10	1·045	·47	·26	4·5
Ditto (on Paradise stock) ..	325	1·044	·26	·19	11
Ditto (ditto)	326	—	·42	·22	—

TABLE B—*continued.*

Name of Variety.	Number of Tree.	Composition of Juice, 1914.			
		Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 Deg. C.
APPLES—*continued.*					
Skyrme's Kernel (on Paradise stock) ..	327	—	·30	·18	—
Strawberry Norman	1	1·054	·32	·53	6
Ditto	2	1·047	·28	·40	6·2
Ditto	3	1·050	·23	·40	5·5
Ditto	4	1·050	·25	·39	6
Ditto	6	1·048	·21	·35	5·5
Ditto	7	1·051	·23	·37	5
Ditto	8	1·047	·22	·36	6·4
Ditto	9	1·052	·24	·39	4·8
Ditto	10	1·050	·24	·38	6·8
Ditto (on Paradise stock) ..	80	1·054	·10	·34	7·4
Ditto (ditto)	81	1·051	·13	·34	7·2
Ditto (ditto	82	1·053	·09	·38	7·4
Sweet Alford (head-grafted on King of the Pippins, 1906)	1	1·047	·14	·15	5·3
Ditto (ditto)	2	1·044	·11	·17	10·5
Ditto (ditto)	3	1·046	·11	·17	9·2
Ditto (ditto)	4	1·042	·10	·12	5·8
Ditto (ditto)	5	1·044	·12	·17	5·8
Ditto (head-grafted on Ecklinville, 1906)	1	1·042	·12	·12	7
Ditto (ditto)	2	1·046	·15	·13	5·4
Ditto (ditto)	3	1·050	·14	·14	8
Ditto (ditto)	4	1·049	·13	·13	5·2
Ditto (ditto)	5	1·050	·14	·12	11
Ditto (head-grafted on Broadleaf Jersey, 1906)	182	1·051	·14	·13	7·3
Ditto (on Paradise stock) ..	328	1·051	·11	·13	11·1
Sweet Coppins (on Paradise stock) ..	383	1·049	·07	·16	9·8
Ditto (ditto)	384	1·048	·05	·12	9·8
Ditto (ditto)	385	1·046	·05	·12	8·2
Ditto (ditto)	386	1·045	·04	·13	9
Tardive Forestier (head-grafted on Hardwicks, 1906)	74	1·047	·28	·45	5·5
Ditto (ditto)	75	1·054	·25	·41	6·2
Ditto (ditto)	76	1·050	·28	·40	6·8
Taylor's Spie (on Paradise stock) ..	417	1·040	·41	·08	10
Ditto (ditto)	419	1·041	·43	·09	10·2
The Bell (on Paradise stock)	387	1·052	·07	·16	10·5
Ditto (ditto)	388	1·052	·06	·16	11
Ditto (ditto)	389	1·048	·07	·14	8·7
Ditto (ditto)	390	1·049	·09	·14	11·7
Ditto (ditto)	391	1·050	·12	·15	12
Thomas Hunt (on Paradise stock) ..	400	—	·22	·12	—
Ditto (ditto)	401	—	·11	·13	—
Ditto (ditto)	402	—	·10	·16	—
Ditto (ditto)	403	—	·06	·09	—
Ditto (ditto)	404	1·052	·07	·12	—
Virgin Mary (on Paradise Stock) ..	20	1·051	·08	·24	7
Ditto (ditto)	21	—	·08	·25	—
White Bache (on Paradise stock) ..	31	1·050	·10	·27	8
Ditto (ditto)	32	1·057	·08	·29	8·7

TABLE B—*continued.*

Name of Variety.	Number of Tree.	Composition of Juice, 1914.			
		Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 Deg. C.
APPLES—*continued.*					
White Bache (on Paradise Stock ..	35	1·056	·09	·36	7
White Close Pippin (on Paradise stock)	39	1·048	·06	·34	6·8
Ditto (ditto)	42	1·050	·05	·24	6·8
White Jersey (head-grafted on Broad-leaf Jersey, 1905)..	153	1·044	·14	·13	4·8
Ditto (ditto, ditto)	154	1·040	·13	·10	3·8
Ditto (ditto, 1906)	155	1·042	·15	·13	4·5
Ditto (ditto, ditto)	156	1·053	·20	·28	4·4
Ditto (ditto, ditto)	181	1·048	·14	·20	3·1
Ditto (on Paradise stock) ..	12	1·043	·08	·15	7
Ditto (ditto)	13	1·044	·09	·14	—
Ditto (ditto)	14	1·053	·05	·13	4·4
White Norman (on Paradise stock) ..	48	1·054	·08	·26	7·7
Ditto (ditto)	49	1·055	·06	·30	6
Ditto (ditto)	50	1·054	·08	·22	7·4
Woolston Spice (on Paradise stock) ..	300	1·054	·11	·24	9·7
Ditto (ditto)	301	1·052	·10	·27	8·1
Ditto (ditto)	302	1·054	·09	·26	6·5
Ditto (ditto)	303	—	·07	·27	—
Yarlington Mill (head-grafted on Hard-wicks, 1906)	118	1·042	·14	·23	5
Ditto (on Paradise stock) ..	91	1·042	·10	·14	8·2
Ditto (ditto)	92	1·040	·11	·16	10
Ditto (ditto)	93	1·040	·10	·15	—
Yeovil Sour (on Paradise stock) ..	269	1·040	·31	·15	7·5
Ditto (ditto)	270	1·035	·20	·12	8·2
Ditto (ditto)	271	1·040	·23	·16	6·1
PEARS.					
Moorcroft	194	1·050	·36	·04	7·1
Ditto	195	1·047	·26	·03	6·8
Ditto	196	1·049	·26	·02	5
Ditto	197	1·053	·44	·08	7
Ditto	198	1·054	·66	·14	6·5

making purposes, the gravity of 1·069 for Eggleton Styre from Ledbury stands out conspicuously in a season such as the one under consideration. Most of the cases of high gravities have been obtained from small lots of apples sent in for examination, and these are, of course, somewhat fictitious owing to the comparatively large loss of water during storage in small bulk.

Referring more particularly to the results shown in Table B, it has been pointed out previously in these reports that trees of the same variety adjoining one another in the orchard or plantation frequently show comparatively large differences in the same season, although if the average results taken over a period of years are considered, they approach one another very nearly. This feature is referred to again more particularly in another section of this Report. In many cases results are given where the same variety has been grown on both the free stock and the Paradise stock. In all cases where Paradise stock has been used, mention is made of it in the table. In all other cases, the stock used has been the free stock. It is evident that the Paradise stock exerts a definite influence on the acidity of the fruit. In nearly all cases the results for fruit grown on the Paradise stock show lower acidities than those of the same variety on the free stock. Differences in the cases of specific gravity and tannin are not so pronounced, and it would be premature at present to make any definite statement as to whether or not Paradise stock influences those characters of the fruit also. It was noticed in the results for previous years that the rates of fermentation in the juices from the Paradise stock generally ruled higher than in those from the free stock, but at that stage it was uncertain if the fact that the trees on the Paradise stock were somewhat younger than the others might not have had something to do with that result. The same tendency to more rapid fermentation in the cases of the juices from the Paradise stock is still noticeable; but it is desirable to obtain the results for a few more years before arriving at any conclusion as to the possible influence of the Paradise stock in this direction.

THE CHEMISTRY OF CIDER SICKNESS.

By C. W. Spiers, B.Sc.

Since the quantitative estimation of tannin in apple juice and cider seemed likely to be much used in the course of the work, it was thought advisable to work out, if possible, a more satisfactory method than those at present in use. This was described in a paper published in the *Journal of Agricultural Science*, Vol. VI., Part 1, p. 77.

Attempts were then made to prepare the tannin from fresh apple juice, but with no success, both a method of extraction with ethyl acetate and a salting out method being tried. This may have been in part due to the fact that the apple juice of the 1913 season contained less than the average amount of tannin-like substances.

Preliminary experiments were then carried out with the object of following quantitatively the sickness fermentation. Fairly large volumes of cider were partially neutralised and infected with a culture of the sickness bacillus. Portions were removed for analysis from time to time, with the results shown in the table below.

Day.	Specific Gravity.	Glucose.	Alcohol.	Acidity.	Tannin.
		%	%	%	
1	1·030	6·75	1·00	—	0·13
3	1·030	4·33	2·00	—	0·15
5	1·018	1·50	2·70	—	0·15
8	1·016	1·46	2·79	—	0·15
12	1·015	1·63	2·00	0·14	0·14
18	1·016	1·60	3·02	0·14	0·14
1	1·041	7·03	1·00	·078	0·15
3	1·034	5·26	1·01	·132	0·15
5	1·013	2·03	2·91	·175	0·15
7	1·016	1·47	3·14	·175	0·16

The only fact to be noted from the above is that the tannin substances are removed too slowly in the ordinary course of the fermentation to be noticeable in the time of the experiments above.

Experiments were then carried out in which the CO_2 formed was also measured. These were similar in method to those of

Macfadyen, Morris, and Rowland, on the quantitative study of alcoholic fermentation. (B., 1900, 33, 2764). The method was as follows. About 550cc. partially neutralised cider was infected with a vigorous culture of the sickness bacillus in the same cider, 25–30cc. being used. Observing the usual precautions, quantities of 120cc. were placed in four 200cc. flasks, sterilised at 150 C., while fitted with the stoppers and tubes as required. The four were then connected with absorption flasks containing 100cc. 2·5N KOH, and incubated at 25 C.

When each flask was taken from the incubator for analysis, a moderately rapid stream of CO_2 free air was drawn through the flasks for about 20 minutes, the cider being frequently shaken meanwhile. A few drops of toluol were added to the cider before analysis in order to stop fermentation. The methods of analysis were as follows :—

CO_2 was estimated by the method of double titration, as used by Macfadyen.

Alcohol was estimated in the usual way by distilling off two thirds of a sample of 50cc. previously made alkaline by the addition of solid NaOH. The density of the distillate is then determined.

Tannin is estimated by the method previously described.

Glucose was estimated as follows :—5cc. of the cider were diluted to about 30cc. and heated to boiling. Hot 10 per cent. basic lead acetate solution was then added cautiously until no further precipitate was formed. After cooling the excess of lead was removed by careful addition of sodium carbonate, 2N approx. An excess of sodium carbonate is to be avoided, as glucose is somewhat rapidly destroyed in alkaline solutions. The lead precipitate, however, settles quite quickly ; and it is easy to avoid an excess by adding the sodium carbonate drop by drop until no further precipitate is produced. The clear solution is then decanted through a filter, washed two or three times by decantation, and finally upon the filter, and made up to 250cc. It is then of convenient strength for use in Bertrand's method of estimation.

(Note.—Although perhaps in routine work it may not be necessary to precipitate with lead acetate before estimating the sugar, the advisability of doing so in the present work was shown by the fact that a sample of cider gave 10·23 per cent. glucose by direct estimation, and 9·68 per cent. after precipitation with lead acetate, a difference well outside the error of the method).

The acidity was estimated by titration with N/10 NaOH. 5cc. of the cider were diluted to about 50cc., and a few drops of 1 per cent. phenolphthalein solution added. The end point can then be seen readily, and most easily if the titration is carried out in a Nessler tube.

In this series of experiments the following results were obtained :

Days.	Glucose Destroyed.	Alcohol.	Co_2.	Alcohol / Co_2.	Tannin.
		%	%		
5	0·875	6·97	29·27		0·11
8	3·056	55·7	40·39		0·10
12	4·100	—	43·74		0·11
8	5·761	30·62	37·75		0·11
12	5·779	29·5	41·44		0·11
4	2·633	25·90	32·68		0·10
8	3·380	67·57	36·51		0·11
12	4·333	28·02	40·61		—
71	4·947	35·75	39·15		0·035
4	2·915	40·77	37·74	1·080	0·12
9	4·621	48·05	41·24	1·165	—
64	5·219	51·98	42·11	1·234	0·056
4	4·865	49·61	39·93	1·243	0·079
8	5·057	44·84	40·99	1·094	—
47	5·277	42·97	40·95	1·049	0·060

In the foregoing table it is to be noted that :—

(1) Although the results are in some cases erratic, on the whole the ratio alcohol carbon dioxide is greater than that in alcoholic fermentation.

(2) The content of tannin-like substances does diminish on longer standing.

(3) The alcohol and carbon dioxide formed do not together account for the glucose destroyed.

With regard to (1) the methods of estimation of alcohol and of carbon dioxide were tested by blank experiments, and were found correct within the limits of the experiment. As to (3), it has been observed that in alcoholic fermentation a certain proportion of the sugar is unaccounted for. Harden and Young (B. 37, 1904, 1052) showed that this was due to the formation of a non-reducing substance from the glucose, which on hydrolysis with 3N HCl after the fermentation regenerated glucose, and accounted for the remainder of it. It is intended to try this method in the case of sickness fermentation.

TRIAL CIDER AND PERRY ORCHARDS.

By B. T. P. Barker.

Reference was made in the Report for 1913 to the trial cider and perry orchards which have been established at various centres in the West of England with trees raised in the Nurseries at Long Ashton. A number of additional orchards have been established during the winter of 1914, particulars of which are given below. One thousand two hundred and thirty-two trees were available for distribution in this way, and in addition sixty-two trees were supplied to members. The accompanying table shows the centres at which the new orchards have been established and the varieties planted in each case. The figures in brackets after the name of the variety indicate the number of trees of that sort.

Also appended are reports received from County Organisers and others on the orchards which were established previous to 1913. It will be seen that, on the whole, the orchards are making satisfactory progress, although in a few cases failures have resulted. Attention may be drawn to the orchard at Killerton, referred to in the Devon report. This differs from practically all the other orchards in being planted in tilled ground instead of in grass land. The trees are making excellent progress, and the high yield last season is especially interesting. The earlier established orchards are now beginning to fruit regularly in most cases, and in a short time it will be desirable to begin a systematic examination of the quality of the fruit at the respective centres in order to ascertain how far local conditions are affecting quality. For the last season or two a few analyses of varieties from some of the orchards have been made, but further reference to these will be deferred until further results are available. It is hoped that in next season's report it will be possible to give a fairly extensive series of analyses. Progress is being made with the soil examination at each centre, Mr. Gimingham having this work in hand.

Devon.—Mr. C. Berry, County Instructor in Horticulture, reports on the experimental orchards in that county as follows: –

Branscombe, near Seaton.—The trees are growing slowly and

NEW EXPERIMENTAL ORCHARDS PLANTED IN 1914–15.

Centre.	Varieties Selected.			
	Apples.			Pears.
	Sharp.	Sweet.	Bitter Sweet.	
Gloucester County Trees.				
Standish Moreton, Stonehouse ..	Cap of Liberty (10) Kingston Black (10) Skyrme's Kernel (10) Cowarne Red (5) Dufflin (5)	Sweet Alford (10) Eggleton Styre (10) Sweet Coppin (10)	Royal Wilding (10) Strawberry Norman (10) Cherry Norman (10)	
Arlingham	Dymock Red (10) Cap of Liberty (10) Skyrme's Kernel (10) Cider Pearmain (5) Yeovil Sour (5)	Sweet Alford (4) White Alphington (10) Eggleton Styre (10)	Knotted Kernel (10) White Close Pippin (10) Yarlington Mill (10)	
Hereford County Trees.				
Kinnersley	Cap of Liberty (10) Dymock Red (10) Skyrme's Kernel (5)	Sweet Alford (10) Eggleton Styre (10) Woodbine (10) Fertile de Caen (5)	Knotted Kernel No. 1 (10) Strawberry Norman (10) Médaille d'Or (10) Royal Wilding (10) Royal Jersey (10) Harry Masters' Jersey (10) Chisel Jersey (10) Yarlington Mill (5) Cherry Norman (10)	

Also 25 strong growing Standards for head grafting,

Monmouth County Trees.				
Itton, Chepstow ..		Eggleton Styre (13)	Strawberry Norman (10) Cherry Norman (10)	
Tyllwyd, Llansoy ..		Sweet Coppin (15)	Royal Jersey (14)	
Old Court, Itton ..				Taynton Squash (15)
Llansaintfraed, Abergavenny ..		Eggleton Styre (22)	Chisel Jersey (11) Royal Jersey, Butleigh (11)	
Llantilio Court, Abergavenny ..	12 strong growing Standards for head grafting.			
Somerset County Trees.				
Brent Knoll	Cap of Liberty (10) Porter's Perfection (5) Lambrook Pippin (5)	Eggleton Styre (10) Sweet Coppin (10) Doux Amer (10) Woodbine (5) White Alphington (5)	Strawberry Norman (5) Médaille d'Or (10) White Close Pippin (5) Brown Snout (5) Knotted Kernel (Type No. 1) (5) Ditto (Type No. 2) (5) Major (5)	
South Barrow	Cap of Liberty (10) Page's Yellow (5) Lambrook Pippin (5)	Eggleton Styre (10) Sweet Coppin (10) Doux Amer (10) Woodbine (5) White Alphington (5)	Strawberry Norman (5) Médaille d'Or (10) White Close Pippin (5) Brown Snout (5) Knotted Kernel (Type No. 1) (5) Ditto (Type No. 2) (5) Major (5)	

NEW EXPERIMENTAL ORCHARDS PLANTED IN 1914–15—*continued.*

Centre.	Varieties Selected.			
	Apples.			Pears.
	Sharp.	Sweet.	Bitter Sweet.	
Somerset County Trees (contd.)				
Blackford	Cap of Liberty (10)	Doux Amer (10) Sweet Coppin (10) Woodbine (5) Eggleton Styre (5)	Cherry Norman (10) Osborn's Cadbury (5) Médaille d'Or (10) Major (5) Dabinett (10) Royal Jersey (Butleigh Type) (5)	
Barrow	Cap of Liberty (15) Skyrme's Kernel (10) Yeovil Sour (5) Foxwhelp (5) Cherry Pearmain	Doux Amer (10) Sweet Coppin (15) Sweet Alford (20) Eggleton Styre (20) White Jersey (5)	Knotted Kernel (Type No. 1) (5) White Close Pippin (5) Médaille d'Or (15) Dabinett (5) Major (5) Knotted Kernel (Type No. 2) (5) Strawberry Norman (10) Royal Jersey (5) Chisel Jersey (5) Cherry Norman (5)	Amphlett (5) Oldfield (10) Taynton Squash (10) Port (5)

Worcester County Trees.				
The Norrest, nr. Malvern ..	Cherry Pearmain (15)	Eggleton Styre (12)	Rouge Bruyère (10)	Blakeney Red (5) Oldfield (5) Barland (5) Moorcroft (5)
Westwood Park ..	Cap of Liberty (10) Dymock Red (6) Foxwhelp (6) Kingston Blacks (6)	Sweet Alford (3) Eggleton Styre (4) White Jersey (5)	Strawberry Norman (3) Royal Jersey (3) Cherry Norman (4)	
Hanley Willian ..	Foxwhelp (5)	Sweet Alford (5) White Jersey (5)	Knotted Kernel (Type No. 1) (5) Major (5)	Taynton Squash (5) Huffcap (5) Holmer (5)

require little pruning. I hope to have the orchard manured during this season.

Dainton, Ipplepen, Newton Abbot.—Planted during 1914. All the trees are alive and free from canker, and are doing well. A few stems have been bitten by sheep, but more protection is promised by the owner. The following particulars of cost of planting may be of interest :—

Cost of labour in planting 144 trees :—

	£	*s.*	*d.*
58 days, digging pits and planting trees . .	8	14	0
2 days, cutting stakes	0	6	0
3 days, men and two horses, dung and soil . .	1	10	0
Carting trees from station	0	5	0
Carriage of trees from Long Ashton	1	1	7
$2\frac{1}{4}$ cwt. of pure dissolved bones	0	8	3
Wire-netting for trees	1	0	0
18 cart loads of dung at 3s. 6d.	3	3	0
	£16	7	10

The cost per tree was about 2s. 3d.

The soil is a limestone. Many large stones were picked from the sub-soil—perhaps half the hole in some pits. Some farmyard manure and leaf-mould were dug into the underspit. These trees were planted with a number of fairly large pieces of limestone in the soil, but they appear to be doing as well as those trees that had apparently much better soil. I had this letter from Mr. Maddicott : "I am very pleased that I took your advice" [after Mr. Maddicott had refused to plant] "and planted my orchard. Everyone who has seen it is delighted with it. Your way was costly, but I am satisfied now that, though new to me, it was the right way."

On February 26th, 1915, I inspected the orchard. Very little pruning was needful.

East Worlington, owner Mr. H. Smyth, J.P.—Planted trees February, 1913. The trees were not pruned in 1914, and very little pruning was needed when I was there on March 8th. All the trees are doing well. Little more can be said as yet.

Kingsnympton, near South Molton Road Station.—I have not pruned the trees much this spring. They are forming fruit-buds well. Attention has again been paid to re-arranging some stakes and wires. Some good fruit was grown. The friction mentioned has now been stopped. Very little canker shows itself.

Killerton, near Exeter.—This orchard has been, and is, cultivated, i.e., it is not a grass orchard. This year it is planted with clover. None of the orchards have done so well as this. Improved Pound

grew some shoots quite a yard long. I pruned these and some of the other trees on March 5 this year. Everybody seems to sing the praises of Killerton orchard. The bailiff tells me that three tons of apples were taken from the trees, 48 in the acre, this year, *i.e.*, five years only after planting. He said that little difference between the varieties as regards cropping was noticed: they all were full to breaking point. The scab reported last year has been removed by spraying, but a little is showing on some other trees that were not thus sprayed. Spraying of these will follow.

Oaklands, Okehampton.—The trees here are making remarkably fine growth where the land is cultivated. A little canker is present on some of these. One tree cankered badly. I headed it back some three years ago, re-grafting it on itself, and a healthy condition now exists. I took up four trees that nearly died of canker, and planted four from Long Ashton, on March 1st, 1915, in place of Cherry Norman. Knotted Kernel and Red Streak are doing well. There is a great improvement in girth, health, and size of those trees that were growing in ploughed soil over those under grass. The cattle have been allowed to enter, and they broke down the stakes and wire-netting. The stakes and netting have now been put right, and the tenant promises that cattle will not again enter.

Gloucester.—Mr. G. H. Hollingworth, Agricultural Organiser for the County, reports as follows:—

The following remarks are based on observations made during visits paid to the County Orchards in March and April, 1915:—

Orchards planted in December, 1908.

Hardwicke.—With a few exceptions the trees in this orchard are doing extremely well, and from the nature of the growth it can easily be seen which varieties are best adapted to the conditions under which they are planted. The trees are now reaching a stage when they should begin to bear, but only a few apples were produced last year. Speaking as a whole, the orchard has made good progress.

Berkeley.—I have never seen trees make better headway in the time that they have been planted than several of the varieties in this orchard. Stout stems and well-balanced heads are the rule, and the only real failure is one tree, which is badly affected with canker, and will have to be replaced. Several of the varieties bore good crops of fruit last year.

Lydney.—Many of the varieties in this orchard bore heavy crops of fruit last season, and I regret to say that a number of trees suffered rather severe injury through being broken when the branches were bent down with the weight of fruit. It is hoped that this will not

happen again, as apart from this damage, the orchard is doing well. Cowarne Red, a splendid cider apple, which has suffered through canker in other places, is growing practically free from the trouble here.

Orchards planted in January and February, 1910.

Dymock.—In all the county orchards where pears are planted the trees are making robust growth, and this remark applies to the orchard at Dymock, which is planted entirely with perry pears. Barland is still unsatisfactory, as the trees are cankered and the young growth is not clean and healthy, though the stems of this variety are thicker than any other in the orchard.

Tibberton. In this well arranged orchard the trees are mostly doing well, and Cowarne Red, which cankered very badly at the commencement, seems to be growing away from the trouble. This orchard is a useful object lesson on the influence of soil on young trees, as in one part of the orchard the land is not so good as the other and the effect of this can easily be seen on the growth made since the trees were planted.

Various.—All the trees of Sweet Alford that were planted in small quantities last year in orchards at the County Asylum, Gloucester, Cheltenham, Kempley, Arlingham, and Compton Greenfield, are doing well. Speaking of this apple, it is safe to say that no other variety sent out from the Institute has made better growth in the county than the one in question. The variety has been introduced this year into mixed orchards on County Council Small Holdings at Berkeley Heath and Churcham, near Gloucester.

Orchards planted in 1915.

Arlingham.—A new orchard containing 100 cider apple trees in eleven varieties has been planted this year on land in the occupation of Mr. W. P. Merrett, at Arlingham, a village on the banks of the Severn, in a district where the industries of fruit-growing and cider-making are carried on. Mr. Merrett undertook the planting, staking and fencing of the trees, and completed the task in a praiseworthy manner.

Standish.—At the instigation of Mr. R. Gray, agent to Lord Sherborne, arrangements were made to plant an orchard at Standish, and well-grown trees were supplied from the Institute for the purpose. As conditions were unfavourable for planting when the trees arrived, they were laid in temporarily with protective material over the roots. When the material was removed and planting about to commence, it was found that the majority of the trees were damaged by voles gnawing the bark on the stems. In view of this misfortune it was decided to plant the trees in a garden and leave them for a season to see how many would recover from the damage.

Hereford.—Mr. A. J. Manning, County Instructor in Horticulture, reports :—

The young orchard at Burghill continues to make sound and steady progress. The trees make a moderate growth, which thoroughly matures and is developing fruit-bud freely in all the kinds.

The trouble caused by the outbreak of canker during the first two seasons has subsided, no new patches having shown themselves this season. All old ones that were cut and coated with grafting wax have almost completely healed over.

The West Country varieties on trial are doing remarkably well with the exception of Kingston Black Improved. This variety does not appear happy. Yarlington Mill is growing and fruiting very freely, and promises to be an acquisition.

The orchard on one of the Small Holdings near Leominster that started badly is still far from satisfactory, but the other two are doing well.

Monmouth.—The following is the report received from Mr. W. J. Grant, Director of Agricultural Education for the County :—

The young cider and perry orchards are, on the whole, making good progress, and in several instances, have commenced to bear fruit. It is, however, a matter of complaint that there has been a delay in the completion of the planting of several cider orchards owing to the varieties it was originally intended to plant the orchards with not being available.

Somerset.—Mr. J. Ettle, County Instructor in Horticulture, writes :—

As regards the report on experimental cider orchards in Somerset, there is very little to add to reports given in previous years. But the value of the experiments is being seen year after year in two ways, particularly :—

(1) Demonstrating varieties which will *not* do well and those which *will* do well in various soils and climates. This is of the first importance : but no accurate report can be given until we have watched results for a good many more years. All varieties of perry pears have grown very well indeed. This is satisfactory, as we have so few of them in Somerset.

(2) Working out the two systems which were started years ago at the Institute, and which were called the "Hereford" "Somerset" respectively : the Hereford budded or grafted low down to the ground and allowed to make its own stem and head ; the Somerset, planting a strong ready grown tree to be head-grafted. Some varieties, such as the Eggleton Styre, Strawberry Norman, and Court

Royal, do very well on the Hereford ; but Kingston Black, Horners, and Cowarne Reds do best on the Somerset systems.

There have been some losses which have been made good. New orchards are being planted at Blackford, Wedmore, on Mr. Francis Duckett's farm, and at Barrow, near Sparkford, for Mr. Dauntsey. About 100 trees have been added to an orchard which we commenced a few years since for Mr. Frank Body, Brent Knoll.

The Perry Pear trees supplied to Mr. Eldred Walker, Chew Stoke, are doing very well indeed. This is not a " County " orchard, but we keep it under supervision.

Worcester.—Mr. R. C. Gaut, Agricultural Organiser for the County, has furnished the following report :—

I have made an inspection of the Trial Cider and Perry Orchards established in various parts of the County, and beg to present herewith a report upon their condition.

Late spring frosts played havoc with the orchards during the flowering period, and at most centres young trees that bore fruit in 1913 are destitute of crop this year. For this reason it is impossible to give a comparative account of the cropping powers of the different varieties.

Newnham Court, Tenbury (*Mr. E. V. V. Wheeler*).—Planted 1908 and 1910. The trees form a complete and regular orchard on the crown and sides of a low hill, of strong soil, with a southerly and westerly aspect. The earlier planted trees have grown into shapely subjects with strong stems and healthy spreading heads. It is worth while noting that Médaille d'Or is again heavily loaded with fruit, and the row of trees of this variety presents a picturesque appearance. The younger section of the orchard is well established and is in excellent health. The orchard is in first class condition ; all the trees are living, and are well protected with tall wire-netting. guards.

Madresfield Court, Malvern (*Mr. W. Crump, Head Gardener*).—Planted 1908. These trees have been planted 40 feet apart with Belle de Louvain plum trees, at equal distances between. The site is a flat even pasture, and the soil is moderately strong. It is quite evident from their appearance that the trees have received more attention than is usually considered necessary for this class of fruit, for they have remarkably stout stems and large symmetrical heads. Late frosts ruined the entire crop of fruit this year. The orchard is in first class condition ; all the trees are living and are well protected by wire-netting guards.

Beauchamp Court, Powick, Worcester (*Mr. W. H. Gabb*).—Trees planted at Bank Farm, Leigh ; planted 1912 and 1913. The site

of the orchard is a rather bleak one, as the trees are planted on the brow and north-westerly side of a low hill of gravelly soil. The older trees are well established, and have vigorous crowns. They are well protected from ground game by wire-netting guards, and from stock by a spiral of barbed wire, which is attached to stout posts driven well into the ground at some distance from the base of each tree. With respect to the younger trees it is quite evident that they have suffered from the effects of the dry season; four of them are dead, and several others occupying the drier positions have not made the same growth as others more favourably situated. This section of the orchard is protected at present solely by wire netting guards.

Woollashill, Pershore (*Mr. J. W. Dee*).—Planted 1908. The trees form part of a fairly extensive young orchard which has been established on strong soil near the base of the hill; they have been planted much more carefully than is usual with this class of fruit. The trees are all doing well, and have been judiciously trained; the pears especially are well-grown considering they have only been planted six years. The orchard is in first class condition, all the trees are surviving, and the stems are well protected against damage by wire netting guards and stout posts surrounded by barbed wire. In the absence of Mr. Dee, his son reported that most of the pear trees have borne ample crops of good sizeable fruit this year.

Staunton Court, Gloucester (*Mr. J. G. Hawkins*).—Planted 1910. The trees have been used for filling up gaps in a very old orchard which occupies some stiff ground on both sides of a small brook; some of them are, therefore, situated in rather dense shade during the growing season. The pears have done remarkably well considering the shortness of the time since they were planted, and have stout stems and well balanced heads; most of the apples are doing well, but some are far from robust. Altogether the young orchard is in good condition excepting for the few apples that are either dead or unhealthy. The form of protection used is one composed of two tall stout posts of green wood, driven well into the ground some six inches from the tree on each side; a narrow strip of wire netting stretched between the posts, and a sprig of gorse at the summit complete the arrangement.

The Stocks, Suckley (*Mr. J. H. W. Best*).—Year of planting 1908. The trees are planted in the valley, partly on an old grass orchard site; they have been used to fill in gaps and also to extend the boundaries of the pre-existing orchard. The soil is stiff. All the trees have good shapely crowns, which present a vigorous appearance. Protection from ground game has been afforded by a wire netting guard, and from stock by a spiral plain galvanized wire attached to a triangle of firmly planted posts. Many of the trees

have unfortunately been barked by cattle, which have been able to insert their heads between the wires where they have become slack. Probably no permanent injury has at present been done.

Greenfields, Upton-on-Severn (*Mr. W. S. Lane*).—Planted 1908. These trees have been planted in a small paddock, and form a compact orchard on stiff marly soil, with a slight southerly gradient. They are making excellent progress, and now possess strong stems and healthy symmetrical heads. The trees are well protected by rough brushwood, which is supported by stout stakes, the whole being well bound together by barbed wire, and forming an affective barrier against damage from stock and ground game. The orchard is in good condition; all the 48 trees reported upon last year are surviving, and some are bearing small quantities of fruit.

Manor Farm, Moor, Pershore (*Mr. T. W. Oldham*).—Planted 1908. The young trees were planted on the outskirts of an old orchard and also in gaps formed by the death of old fruit trees. The soil is gravelly, and is therefore liable to suffer severely from drought. Many of the trees succumbed during the dry year 1911, but on the east side, where the soil is more retentive of moisture, good growth has been made.

Out of 50 trees planted, only 13 (mostly pears) are surviving, and the majority of these have been barked and rubbed by animals The trees are quite unprotected, consequently several of them have been completely destroyed by stock. It is not worth while continuing reports upon the trees at this centre.

Powick Asylum, Powick, Worcester (*Mr. G. Braine Hartnell, Medical Superintendent*).—Planted 1908. The trees have been planted on the westerly face of a low clay hill, and form a compact orchard. Careful attention has been paid to pruning, and the heads are now strong, healthy, and well balanced. Protection from cattle is afforded by means of four stout posts and two strands of barbed wire; each tree is also encircled by a guard of wire netting. Several of the posts require renewing if the pasture is to be grazed by cattle. The orchard is in first class condition, and all the trees are living.

Butleigh, Somerset.—Mr. R. Neville-Grenville sends the following report:—

Of these trees 36 were planted at Butleigh Hill, in an old orchard, but on properly prepared stations in fresh soil. None of them can be said to have made satisfactory progress, many have produced no wood growth, but plenty of fruit buds. The best are by no means vigorous.

Fourteen trees were planted in an old orchard at Holman's Farm under similar conditions. These have done better, but have not

made the amount of growth which may be expected after six years. They do not compare favourably with other trees under the same conditions, but which are double grafted on the Morgan Sweet stock.

Harper-Adams Agricultural College, Newport, Salop.—Mr. G. T. Malthouse reports :—

Growth on the cider and perry plantation was very strong last year. The late frosts destroyed the bulk of the crop, which would otherwise have been heavy. Médaille d'Or was the only variety that furnished any crop. Wood was well ripened last autumn, and the trees are in a healthy condition, no trace of disease being noticed.

The head was blown off one cider apple tree in a heavy gale in March. All the trees were sprayed twice, as follows :—February, 1914, Caustic Winter Wash ; June, 1914, Arsenical Wash.

Frampton Cotterell, Gloucester.—The following has been received from Mr. J. P. Eley :—

I beg to report that the cider orchard which was planted with trees received from the National Fruit and Cider Institute is making excellent progress. Twelve months ago I put a small quantity of farm-yard manure and basic slag around the base of each tree, and dug it in lightly. The effect of that treatment is quite marked, and I am quite convinced that it will well repay the outlay. The trees have all been pruned, and are looking very promising.

Chewstoke, Somerset.—Mr. Eldred G. F. Walker writes as follows :—

As regards the orchard planted by me, the perry pear trees did not make so much wood growth during 1914 as they did in the previous years, but there has been very considerable development of fruit bud. I cannot account for this check in growth except it was by reason of the very late frost experienced, and which played havoc with the set of young fruit. Two more trees of the Claret variety died out. It seems a sheer impossibility to grow these on my soil. I lost three heads blown from trees, and this disclosed the fact that all three had been tunnelled by the larva of the goat moth. This is my first experience of seeing such in so young wood, and I think that its presence is due to the slight chafing some of the trees received against the stakes when they broke loose in the gale three years ago. As a result of this I am having all ties renewed this winter when weather permits. I had a very fair crop of Taynton Squash, a fine one of Moorcrofts, a fair number of Oldfields, and a sprinkling of Pine or Pint pears. The Barlands are evidently of two varieties ; several broke bud from a week to ten days earlier than the other and shed their leaves a fortnight earlier. As a whole the trees have

done well on what was considered to be nearly worthless soil. The apple trees continue to do very badly, and will seemingly never make trees worthy of the name. Like all stunted trees they bloom profusely, and it was noticeable that the two ranks of pear trees beside them were the only two in the whole orchard in which every tree set its blossom.

Aspall Hall, Suffolk.—Mr. J. B. Chevallier's report is as follows :—

The standard trees are healthy and continue to develop in size. They were sprayed March, 1914, with lime and salt. Owing to drought there was nothing of a crop on any of the trees ; excepting Skyrme's Kernel, Cremiere, Broadleaf Norman, Strawberry Norman, Never Blight, and Oldfield (pear).

Woolston, North Cadbury, Somerset.—Messrs. Osborn and Son state that the trees are still making satisfactory progress.

Upton, Loders, Dorset.—Mr. E. C. Parslow, County Instructor in Horticulture, has forwarded the following report :

Most of the cider trees planted at Loders are making very satisfactory progress. There is still some canker in evidence, mostly on Virgin Mary, and this has necessitated the removal of a few well placed branches which to some extent has upset the balance of the trees. At the same time the disease is being held in check by painting with " H. Emulsion." The trees will from now onwards be allowed to grow as naturally as possible, and with a few exceptions will not be pruned except to remove misplaced branches. On some trees branches which must be removed within a few years, have been left in, firstly, because I consider their presence beneficial for a few years, and, secondly, to provide material for demonstrating. It is hoped to be possible to make good use of the orchard for this coming season. I may add that, though this orchard is not ideal, it is far ahead of any other in the county, with the possible exception of one belonging to a private gentleman which was planted without any regard to expense. It is serving a very useful purpose in this county, which will increase as time goes on.

SOME SPRAYING EXPERIMENTS ON THE SUMMER STAGE OF AMERICAN GOOSEBERRY MILDEW.

By B. T. P. Barker and A. H. Lees.

Late in the summer of 1914 an outbreak of American Gooseberry Mildew, which threatened to become severe, appeared in the Institute plantations. The opportunity was taken to carry out a series of preliminary experiments, having for their object the control of the summer stage of the fungus by spraying.

It is known that the disease is carried over from year to year by the formation of winter spores, the ascospores, which are produced in special resistant structures termed perithecia, and are capable of withstanding unfavourable conditions more successfully than the thin-walled spores, or oidia, formed during the course of the summer growth of the fungus. In the normal course of the life history of the fungus, after the infection of the gooseberry plant on the young shoots or leaves has taken place in the spring, a crop of the summer spores is rapidly formed. These spread to other parts of the plant and to fresh plants, and in this way the disease is dispersed rapidly during the summer. In due course the affected parts of the plant cease to produce fresh supplies of the summer spores, and the formation of the winter spore stage begins. It is clear, therefore, that in attempting to deal with this disease there are two phases which have to be considered in connection with any question of treatment, viz. (*a*) the summer phase, including the distribution and increase of the disease during the summer months of the year by means of oidia, and (*b*) the hibernation period resulting from the cessation of the supply of summer spores and the production of winter spores, by means of which an outbreak in one season is able to produce another outbreak the following summer. In the experiments under consideration no endeavour was made to deal with the latter side of the problem. It is evident that if the development and spread of the summer stage could be held in check sufficiently, the occurrence of the winter stage would be so much reduced, that outbreaks the following season would be relatively few. The series of experiments described below was

planned to ascertain how far control over the development and distribution of the summer stage could be obtained by ordinary spraying methods.

A priori it appeared probable that to obtain success in control of the summer stage of the disease two conditions must be fulfilled. Firstly, a spray should be used that would kill as much as possible of the conidia and mycelium present on the bush; and, secondly, this should be followed up by a protective spray to keep the already sprayed leaves free from chance spores from external sources. As an example of the first kind, which may be called a " hitting " spray, one may name liver of sulphur; while ordinary Bordeaux mixture is typical of the second class of " cover " sprays.

Accordingly the first plantation of bushes treated was divided into a series of plots, these being respectively sprayed with the following mixtures :—

1. Soluble Sulphur .. .. 5lbs.
   Soft Soap .. .. 20lbs.
   Water .. .. .. 100 galls.
2. Liver of Sulphur .. 4lbs.
   Soft Soap .. .. 20lbs.
   Water .. .. .. 100 galls.
3. Lysol .. .. .. 1 gall.
   Water .. .. .. 100 „
4. Whiting .. .. .. 800lbs.
   Glue .. .. .. 100lbs.
   Potassium dichromate .. 6lbs.
   Water .. .. .. 100 galls.
5. Soluble Sulphur .. .. 4lbs.
   Paraffin Emulsion (see below) 100 galls.
6. Lime Sulphur, 1 part .. $3\frac{1}{3}$ galls. (concentrated commercial)
   Water .. 29 „ .. 100 „
7. Slaked Lime .. .. Equal parts.
   Flowers of Sulphur .. „ „

Soluble Sulphur is an American preparation designed to supplant lime sulphur. It is a dry yellowish powder, smelling of sulphuretted hydrogen, and contains no calcium.

As cover sprays, applied across all the plots in a direction at right angles to the above, the following were tried :—

1. Lime Sulphur .. .. 1 gall. manufactured solution.
   Water .. .. .. 29 galls.
2. Bordeaux Powder.
3. Slaked Lime and Flowers of Sulphur in equal parts.
4. *Soda Bordeaux.*
   Copper Sulphate .. 8lbs.
   Washing Soda .. .. 15lbs.
   Water .. .. .. 100 galls.
5. *Ordinary Bordeaux.*
   Copper Sulphate .. 8lbs.
   Quicklime .. .. 8lbs.
   Water .. .. .. 100 galls.

The varieties of gooseberries in the trial were :—

Leader.
Keepsake.
King of Trumps.
Langley Gage.
May Duke.
Whinham's Industry.
Whitesmith.

Conclusions as regards defoliation and prevention of disease could not be satisfactorily drawn from these trials, as a leaf spot disease (*Glœosporium ribis*) in one corner of the piece caused considerable independent leaf fall, and the lateness of the outbreak (end of July) did not allow the disease to make proper headway after the bushes were sprayed. There was no marked difference as regards intensity of reappearance of the mildew in this trial. It reappeared fairly generally, but only slightly, on all the more susceptible varieties.

In the course of this experiment it became more and more evident that for a "hitting" spray to be effective it must wet the fungus. The mildews, however, are extremely difficult to wet, partly, no doubt, owing to the numerous air spaces between the individual spores of the dense masses of oidia and superficial mycelium. Two per cent. soft soap solution is not enough, and it was not until paraffin emulsions were tried that success was obtained. From previous spraying trials against Woolly Aphis on apples it was found that the most wetting combination was an emulsion of paraffin in soft soap, containing 2 per cent. of each. Less paraffin than 2 per cent. failed to wet; and more paraffin and less soap *e.g.*, 5 per cent. paraffin and 1 per cent. soap, caused wetting, by means of a paraffin film, however, instead of by the aqueous solution. This combination would certainly, therefore, be liable to burn. From previous trials of gooseberry trees it was known that a 2 per cent. emulsion caused very little damage.

Accordingly in the next trial on some more bushes which had subsequently become infected, the 2 per cent. emulsion was tried by itself, and in conjunction with soluble sulphur and lysol. The hitting sprays were :—

1.	*Paraffin Emulsion* 2 per cent.	
	Soft Soap	20lbs.
	Paraffin	2 galls.
	Water	100 galls.
2.	Paraffin Emulsion	2 per cent.
	Soluble Sulphur	4lbs. per 100 galls.
3.	Paraffin Emulsion	2 per cent.
	Lysol	1 per cent.
4.	Whiting	800lbs.
	Glue	100 „
	Water	100 galls.

The cover sprays were :—

1. Whiting wash as above.
2. Ordinary Bordeaux .. .. 8 : 8 : 100 (as above).
3. Soda Bordeaux .. .. 8 : 15 : 100 ,,
4. Lime Sulphur .. .. 1 to 29 ,,
5. Soluble Sulphur .. .. 4 : 100 ,,
6. Lime and Sulphur .. .. Equal parts. ,,

A control was left.

There was no leaf spot disease in this block of bushes, so that results from the cover sprays, which went across the varieties, have some value. The defoliation produced by the sprays and the subsequent re-appearance of mildew were noted. An arbitrary system of marks was used, the worse defoliated bushes being given more than the slightly defoliated. Similarly marks were given with reference to the re-appearance of the disease. These were then carefully averaged.

As the disease appeared so late in the year the results can only have a tentative value.

Lime sulphur, soda bordeaux, and soluble sulphur produced rather bad defoliation, approaching 75 per cent. of the total possible. The lime sulphur produced its effect almost immediately, while the full effect of the other two was not visible till three or four weeks after spraying. Ordinary bordeaux only produced about 10 per cent. more defoliation than the control, and was the best cover spray used as regards absence of leaf damage.

The results of the re-appearance of disease may be given, though, owing to the small amount they cannot be relied on. Soda bordeaux gave by far the best results. All the other washes were approximately equal. The trials brought out very noticeably the resistance of the variety Whitesmith, both to the mildew and to spray damage.

One other point may be mentioned, viz., the behaviour of paraffin emulsion. On those bushes not sprayed with a cover wash it produced no defoliation. At the same time it wetted the mildew perfectly, and, judging from a microscopical examination, it killed the conidia. It did not, however, suffice to protect the already sprayed foliage from reinfection.

The most successful treatment of those tried, taking lack of defoliation and protection against disease both into account, was that of 2 per cent. paraffin emulsion followed by a cover spray of ordinary bordeaux.

It is intended to continue the experiments during the coming summer.

EXPERIMENTS ON BIG BUD MITE.

By A. H. Lees.

Of methods of combating this mite in the migratory stage there are at present only two. One, that of dusting the foliage with mixtures of lime and flowers of sulphur, entails danger of burning the foliage, while the other, consisting of repeated applications of soft soap and quassia mixture, is exceedingly laborious. Both have given unsatisfactory results when used by growers, though some successes are claimed.

Trials with Sticky Sprays.

The idea of covering the bushes with a sticky substance during the migratory period was suggested to the author, and accordingly trials were made to obtain a satisfactory fluid.

The conditions to be fulfilled were as follows :—

(1) It must be capable of being applied through a spraying machine.
(2) It must leave a sticky coat, when dry, that will remain so for a month at least.
(3) It must be non-injurious to the bush.
(4) It must not be more than moderately expensive.

These conditions are difficult, and it may be stated at the outset that all have not been satisfied.

After some preliminary trials in the laboratory an emulsion of a mixture of 10 per cent. vaseline and 10 per cent. boiled linseed oil in 1½ per cent. soft soap was found the most satisfactory.

This mixture, while warm, was sprayed on to sixteen black currant bushes on April 14. It was found, however, that the addition of boiled oil caused a too quick drying ; and, therefore, on April 29 a 20 per cent. emulsion of vaseline in 1½ per cent. of soft soap was applied to eight of the last sprayed bushes, and to six fresh bushes. More bushes were sprayed with this mixture on May 11, and half those treated on April 29 were re-sprayed.

Those twice sprayed on April 29 and May 11 showed, as was to be feared, a considerable amount of defoliation. The sticky coating

was fairly good, but the process was difficult owing to the quantity of foliage present. In the winter all the treated bushes showed less big bud, although control bushes were as bad or worse. The greatest reduction was found in those that had been twice sprayed on April 29 and May 11, but these had also suffered the most from defoliation. The difference was, indeed, striking, the attacks having been reduced to approximately one-third of the previous amount.

This method is not regarded as satisfactory, as the liquid is not easy to apply and considerable defoliation and also some amount of dead wood resulted ; but the results are given in order to show the possibilities, if a satisfactory sticky coating could be devised.

Early Spring Treatment for Big Bud.

While experimenting in another direction it was discovered by accident that strong soft soap solutions had a considerable power of penetration into big buds. The original observation was made in December on some material indoors, where the temperature was considerably above that outside. This suggested the possibility of attacking the mites before migration from the buds took place. At first an attempt to penetrate the buds on bushes growing outside was a complete failure; but, pending the slight opening of the big buds, which occurs early in the spring, experiments were conducted indoors to find the best conditions for spraying. These conditions were obviously those that gave greatest opening of the big buds. At first the mistake was made of taking any big bud material that came to hand whether from an old or young bush, and no account was taken of the variety. This led to considerable confusion, which was only cleared up when twigs from one bush only were used for experiment.

The following factors were then found to exert influence on the possibility of penetration of spray fluid into the big bud.

(*a*) *Root Pressure.*

This, as was to be expected, only made itself felt gradually, but is a very important force. Until the root pressure begins to increase early in the spring, practically no penetration could be secured out-of-doors.

(*b*) *Variety.*

Some varieties remained difficult to penetrate, even at so late a time that the normal buds were beginning to shoot.

The varieties sprayed were Ogden's Black, Boskoop Giant, Black Prince, Victoria, and Goliath. Of these Boskoop Giant is especially difficult to penetrate.

(*c*) *Age of Bushes.*

On the whole young vigorously growing bushes are rather harder to penetrate than older bushes of the same variety. There is not, however, a great deal of difference.

(*d*) *Temperature.*

This does not appear to play an important part in causing opening of the big buds on bushes outside.

(*e*) *Spray material.*

The strength of the soft soap solution should not be less than 10 per cent. (10lbs. per 10 gallons). The use of 20 per cent. or of 10 per cent. paraffin emulsion did not greatly enhance the penetrating power of the solution. Rainy weather following shortly after spraying greatly increased its efficacy.

The laboratory tests on the effectiveness of the spray fluid were made by dipping cut-off shoots into the solution to be tested, which had been previously deeply dyed with a stain, such as eosin. The shoots were then allowed to dry, after which the big buds were divided vertically down the middle. They were then microscopically examined, and the penetration of the fluid judged from the stained tissues.

Penetration largely takes place at the bottom of the outermost bud scales, and not nearly so frequently from the apex of the bud as would be naturally expected.

When spraying a bush, or part of a bush, in the plantations, the spray solution was also deeply coloured with a stain.

Unfortunately, even in the spring, when the normal buds began to open, perfect penetration of the big buds could not be obtained. The best conditions were caused by rain following the application of the spray. The buds then became full of diluted soft soap solution, which completely drowned the mites. Soft soap solution appeared to have no direct action on the mites, as they could live in 20 per cent. solution for some considerable time, death only occurring from drowning.

In judging the effectiveness of penetration the following method was adopted. Buds were divided roughly into three kinds, those not or only very little penetrated, those slightly to well penetrated, and those well to completely penetrated. By a rough system of marks corresponding to these divisions some idea of the effectiveness could be judged. Even in the spring it was not often that more than 50 per cent. to 75 per cent. penetration could be obtained, and it was owing to this that attempts were made to combine the soap solution with a substance that should poison by its vapour. Some number of substances were tried, among the most successful of which was oil of mirbane. By its means mites that had not been

reached by the soft soap were apparently killed. Unfortunately however, subsequent examination showed that they were only anæsthetised. Buds were treated with an emulsion of oil of mirbane in soap. Those opened after the first day showed motionless mites which recovered motion only after five hours' exposure to the air. Those opened on the second day recovered after one hour, and those opened on the third day had already recovered. At the same time there were many dead mites present; but these were not necessarily killed by the spray, as there appear always to be a certain number of dead in the big buds.

Unstable Paraffin Emulsions.—By keeping the amount of soft soap very small it is possible to obtain a paraffin emulsion that will remain long enough to admit of the ordinary spraying operations without much deemulsification during the process. With the hard water of Long Ashton it was necessary to use about ·6 per cent. for 20 per cent. of paraffin, and about ·4 per cent. for 10 per cent. paraffin. Such emulsions, when they strike an object after being sprayed quickly, liberate a small quantity of pure paraffin. It was found possible, by the use of such emulsions, to get very good penetration into big buds, the penetration being secured by paraffin in this case, instead of by soft soap. The stronger emulsion was very successful, and caused almost 100 per cent. mortality among the mites. Such a drastic treatment might have been expected to cause extensive burning of the opening normal buds, but no such damage occurred.

In accordance with these results from laboratory experiments, the following mixtures were tried out of doors on badly attacked black currants, about the middle of March. At this time the normal buds were just showing green tips.

1 10% Soft Soap.
2 10% ,, ,, + 10% Paraffin in Emulsion.
3 ·4% ,, ,, + 10% ,, in Unstable Emulsion.
4 ·6% ,, ,, + 20% ,, ,, ,,
5 10% ,, ,, + 2% Oil of Mirbane in Emulsion.

After 10 days there was no sign of burning from any of these mixtures.

THE APPLICATION OF SPRAY FLUIDS TO TREES IN THE DORMANT CONDITION.

By A. H. Lees.

The subject of winter washing of fruit trees is one on which much uncertainty prevails. The number and variety of winter washes put on the market with their assertions of lethal powers over many fungus and all insects, whether in the egg stage or otherwise, is only matched by the paucity of detailed information of successful results. It is, indeed, a field full of possibilities, but as yet without many successful results. Spraying trees in the dormant condition has many advantages, and a really successful fluid capable of killing eggs or inhibiting egg hatching would be a great asset to the fruit grower. Among the advantages may be cited the economy of fluid used owing to the leafless condition, comparative ease of obtaining labour, slackness of other work, and non-interference with the subsequent busy season.

In order to test certain of the more commonly recommended non-proprietory mixtures an experiment was begun at Long Ashton in March, 1914.

For this purpose eggs of Red Spider, Larger Winter Moth, Mussel Scale, and Apple Psylla were used as tests, and the spray fluids, as under, were applied to them in the laboratory.

(1)	2%	Caustic Soda.									
(2)	3%	,,	,,								
(3)	5%	Paraffin.	2%	Soft Soap in the form of an emulsion.							
(4)	10%	,,	2%	,,	,,	,,	,,	,,			
(5)	5%	Paranaph.	2%	,,	,,	,,	,,	,,			
(6)	10%	,,	2%	,,	,,	,,	,,	,,			
(7)	2%	Caustic Potash.	2%	Soft Soap.							
(8)	2%	,,	,,	1%	,,	,,	2%	Paraffin as an emulsion.			
(9)	2%	,,	,,	1%	,,	,,	5%	,,	,,	,,	
(10)	2%	,,	,,	1%	,,	,,	10%	,,	,,	,,	
(11)	2%	,,	,,	1%	,,	,,	2%	Paranaph.			
(12)	2%	,,	,,	1%	,,	,,	5%	,,			
(13)	2%	,,	,,	1%	,,	,,	10%	,,			

The paranaph was made by dissolving 10 gr. of naphthalin in every 100 gr. paraffin. This liquid was then used in the same way as paraffin to make an emulsion in the soft soap. In the case of the

red spider and apple sucker eggs the twigs on which they had been laid were dipped in the various fluids to be tested, drained, and left with their lower ends in water. It was necessary to cut the psylla infested twigs off the trees within a fortnight of their normal hatching period ; otherwise no hatching would take place on the control. The eggs of the Great Winter Moth were laid by a late emerging female in the laboratory, and three eggs were taken for each test. Small pieces of bark heavily infested with mussel scale, then in the egg stage, but covered by the dead female scale, were used as the fourth material to be tested. Drops of the liquid to be tested were placed on the scales till completely wet after which they were allowed to drain. Similar treatment was given to the Winter Moth eggs. Both were then allowed to dry, and subsequently placed in covered watch glasses.

The results are included in the two tables appended :—

Results on April 2.—Nos. 1, 2, and 7—13 contained 2 or more per cent. of caustic potash or soda, and all caused shrivelling of the eggs of the Larger Winter Moth. These washes also seemed to have some effect on Red Spider eggs, but not a very marked one. Red Spider proved themselves very resistant to any wash. None of the washes completely stopped hatching of the psylla except No. 13, which (see subsequent table) killed the whole shoot as well.

In the second table, which represents the final observations, it will be noticed that all the fluids tried prevented hatching of the eggs of the Large Winter Moth, which thus seem very sensitive. The Red Spider eggs proved resistant to all. The same applies to the Apple Sucker, except as regards the 3 per cent. caustic soda, which killed both eggs and shoot. The mussel scale was most influenced by those fluids containing caustic soda or potash, which greatly reduced or entirely prevented hatching. It must, of course, be borne in mind that these results were obtained indoors, and that under field conditions, where the caustic alkali would be speedily washed away, very different results might be obtained.

Wash.	Large Winter Moth.	Red Spider.	Apple Psylla.
1	Eggs shrivelled.	Not hatched. Shoot dormant.	Not hatched. Shoot dormant.
2	,, ,,	2 eggs hatched. ,,	,, ,, Eggs turned brown.
3	Eggs slightly flattened but healthy.	Fair numbers hatched. ,,	Hatched in numbers. Buds bursting.
4	,, ,, ,, ,,	1 egg hatched. ,,	,, ,, ,, Buds open.
5	Eggs healthy, unhatched.	Hatched in numbers.	No eggs on shoot.
6	1 egg flattened, 2 healthy.	None hatched. Buds bursting.	Many hatched.
7	Eggs shrivelled.	1 hatched. Shoot dormant.	Few hatched. Buds well open.
8	,, ,,	1 ,, ,, ,,	,, ,,
9	,, ,,	1 ,, ,, ,,	Fair number hatched. Flowers nearly open.
10	2 ,, ,, One healthy.	Many ,, Shoot in leaf.	Few hatched. Buds open.
11	Eggs shrivelled.	1 hatched. Shoot dormant.	Fair number hatched. Leaves out.
12	,, ,,	Fair number hatched.	Few hatched. Leaves out.
13	,, ,,	1 hatched. Shoot dormant.	Fair number hatched. Leaves out.
Control	Not hatched.	Hatched.	Hatched.

Wash.	Large Winter Moth. Observed April 9.	Red Spider. Observed April 9.	Apple Sucker. Observed April 9.	Mussel Scale. Observed May 5.
1	Eggs shrivelled.	Many hatched.	Negative result (due to lack of enough eggs).	A few hatched.
2	,, ,,	,, ,,	Shoot and eggs killed.	Many ,,
3	Crinkled. Not hatched.	,, ,,	Hatched.	Few ,,
4	One crinkled. None hatched.	,, ,,	,,	Many ,,
5	3 crinkled. None hatched.	,, ,,	Absent.	,, ,,
6	1 ,, ,, ,,	,, ,,	Hatched.	,, ,,
7	Eggs shrivelled.	,, ,,	,,	None ,,
8	,, ,,	,, ,,	,,	,, ,,
9	,, ,,	,, ,,	,,	Very few ,,
10	,, ,,	,, ,,	,,	None ,,
11	,, ,,	,, ,,	,,	Very few ,,
12	,, ,,	,, ,,	,,	None ,,
13	,, ,,	,, ,,	,,	,, ,,
Control	All hatched.	,, ,,	,,	Hatched in numbers April 29.

WINTER COVER WASHES.

By A. H. Lees.

In the Annual Report for 1913 brief mention was made concerning the results obtained in the series of experiments on lime washes. Since that time the work has been continued, and the results obtained up to the end of the spring of 1914 have been published in the "Annals of Applied Biology," Vol. I., p. 304. Only a very brief summary can be given here as the experiments had not then reached a satisfactory conclusion. A large number of different mixtures were tried, but they may be divided into those containing whiting as a covering body and those containing lime. Of the former the most satisfactory was the following :—

	Whiting.	Glue	Starch.	Potassium Dichromate.	Water.
Parts by weight	8	$\frac{1}{8}$	$\frac{1}{4}$	1-64th	10

This showed very good sticking qualities, largely due to the action of the dichromate. This salt acts on gelatine, the fundamental body in glue, causing it to become insoluble in the presence of light.

It was thus possible to have the glue in solution until the mixture was sprayed on to the tree when, owing to the liquid being then in a thin layer instead of in bulk, the glue became insoluble and the coating became resistant to rain. It had, however, two disadvantages. Firstly, it was rather expensive, its cost being 2d. per gallon ; and secondly, it necessitated rather large quantities of hot water.

Attempts were therefore made to obtain a satisfactory mixture with lime as the covering body. The whiting formula with simple replacement of whiting by lime was a failure owing to chemical action occurring between the alkali and the glue by which the glue completely lost its adhesive properties. A large number of substances were then tried with the hope that they would increase the sticking power of lime. Among the most important of these were aluminium salts. The addition of either aluminium sulphate or alum to fresh slaked lime causes the formation of aluminium hydroxide according to the formula.

$$3Ca(OH)_2+Al_2(SO_4)_3=3CaSO_4+2\ Al(OH)_3.$$

This body causes great thickening of the mixture and gave good results in the laboratory. On the large scale, however, it was not successful as it flaked extensively. Other substances tried were calcium chloride, water glass, plaster of paris, and cement, all of which gave very brittle coats, and paraffin and skim milk, which gave powdery coats.

Many of these mixtures were tried on the large scale, but none of them gave such good results as the whiting formula, which was the best produced up to the end of the Spring of 1914. In carrying on these experiments it was necessary to determine what methods of slaking lime gave the best coat when used by itself. It was found that while hot water gave the thickest coat the firmest was obtained by using cold water and allowing the mixture to stand for 12 hours before use. When, therefore, lime spraying is done without addition of any other substance it is strongly urged, if possible, to allow the mixture to stand over-night before application. This can be effected with economy in tubs used by adding only one third of the total quantity of water required, and diluting immediately prior to application. By this means one 40 gallon tub will hold enough for 120 gallons of wash. To decide in what way lime wash was effective in combatting the apple sucker twigs, on which eggs had been laid were coated and kept in the laborotory. When the controls had hatched the lime was carefully dissolved off the treated twigs. It was then found that in most cases the egg-shell had split, but the larva had failed to get out. In other cases the larva had succeeded in getting out, but was held imprisoned in the lime coat. Only a very few succeeded in reaching a bud. It follows, therefore, that the action of the lime is a mechanical one, and the more resistant it can be made to rain and other adverse influences the more successful it will be.

In the autumn of 1914 further attempts were made to find an adhesive mixture. It is hoped to publish a further paper on the results so that they are only given here in brief.

It was felt absolutely necessary, after experience, in the field, to find a mixture that could be made without hot water and at the same time not costing more than about 1d. per gallon.

The following substances were tried :—

Lime and starch.
„ „ casein.
„ „ resin.
„ „ watery extract of dung.
„ „ paper pulp.
„ „ „ „ and starch.
„ „ boiled linseed oil.

These substances were added in varying quantities and often in

different ways, and under different conditions, but though some were superior to lime alone none showed a superiority commensurate with the increased cost.

Glue is supposed to be insoluble in alkalies, but it was thought advisable to investigate the action of alkalies on its solutions. On this being done it was found that cold lime water added to cold glue solution produced no insoluble precipitate for several hours. Even so strong an alkali as 10 per cent. caustic soda had no immediate action if added quite cold. Milk of lime was also without immediate action if quite cold and completely slaked. Both these conditions must be fulfilled or the glue is rendered insoluble.

Accordingly mixtures of cold slaked lime and glue were made up which proved decidedly superior to lime alone though the mixture under any other conditions was greatly inferior to lime alone. It was soon found, however, that these mixtures dried, when put on a tree, before the feeble alkali had had time to act on the glue to render it insoluble. It was, of course, desired so to regulate the mixture that though the glue should be in solution before being applied it should become insoluble before the mixture had completely dried on the tree. The most reliable way to obtain the desired conditions was found to use the lime thoroughly slaked and cold, and then to add a small quantity of potassium dichromate immediately before application. By this means a hard gritty coat was obtained that was very resistant to rain. The second way was to add the glue to the lime mixture when this was still warm, that is at about body temperature. This often produced most remarkably resistant coats (owing to part of the glue being made insoluble), but was a somewhat unreliable method as a slightly too great temperature of the lime would have a too drastic action, thus rendering the glue insoluble too soon.

The formula for the dichromate mixture is :—

Lime.	Glue.	Potassium dichromate.	Water.
30lbs.	2lbs.	$\frac{3}{8}$oz.	10 gallons

It is necessary to use more lime than usual as the glue has a physical action on the liquid, causing it to have greater spreading powers. A gallon of the liquid has, however, greater covering powers than ordinary lime wash of the 2lbs. to a gallon formula, so that this does not mean that more lime is used to spray a given area. The cost of the mixture is about $1\frac{1}{4}$d. per gallon. The glue can be dissolved in a separate vessel by standing the latter in the hot slaking lime.

NOTES ON TREATMENT AGAINST CERTAIN INSECT PESTS.

By A. H. Lees.

Summer Spraying against Mussel Scale.—In the following table the results are given from a trial of various spray fluids, mostly applied in the summer stage. In most cases two trees were treated, one badly and one slightly attached. In no case was any spray injury observed. The whiting and lime coats had been applied in the course of other experiments, but the results were observed as a part of this experiment. "Soluble Sulphur" is a powder resembling liver of sulphur, but which is, however, very much cheaper. It is made by the Niagara Spray Co., U.S.A. The two covering washes caused a later date of hatching than the controls, which hatched about the middle of May. Otherwise they did not prevent a considerable infestation. The four following appeared to kill those larvæ that were present at the time of application. The two sulphur sprays had a more powerful action. They not only killed all larvæ present when applied, but also in some way stopped others settling down, as on the second examination only dried larvæ in the stage that they appeared on the controls on June 6th could be found. Their action might have been to prevent hatching or the resulting sulphur coat on the tree may have killed or warded off later hatched larvæ. At any rate they acted as a specific.

Treatment against Woolly Aphis.—Woolly Aphis of apples does great damage to nursery stock in many fruit growing districts, especially on light soils. The remedies so far advised are unsatisfactory in that they must be constantly repeated throughout the summer in order to keep the pest down. While its life history in England is not yet certain, it is difficult to know in what stage to attack it; but it seems certain that migration from the root is the cause of much of the summer infestation, though a possible migration from the elm cannot be ruled out till the point has been satisfactorily proved one way or the other for English conditions. The following experiments were designed to test certain soil insecticides; but, as the results were negative, they will be only given in brief.

Substance Used.	Applied.	Result on June 6.	Result on July 16.
Lime 2lbs. Glue ⅛lb. Starch ¼lb. Pot. Dichromate 1-64th lb. Water 1 gallon	Early in April.	Scales few and late in hatching but healthy.	Most dried up but some normally developing.
Whiting 6lbs. Glue ⅛lb. Starch ¼lb. Pot. Dichromate 1-32nd lb. Water 1 gallon	,,	Scales later in hatching than control but apparently developing normally.	
MacDougall's Summer Wash 1 in 50	May 28	Normal in colour and not dried up. Possibly living.	Many quite normal but others remaining at the June 6 stage and dried up.
Vistoline 1 in 100	,,	Half the scales normal. The rest rather dark in colour but none dried up.	Some normal and others dried up in the June 6 stage.
Lysol 1 in 100	May 30	Only a few specimens present. Nearly all dried up.	A few dried up in June 6 stage but most developing normally.
Paraffin Emulsion 2% Paraffin 2% Soft Soap	May 28	Not many present, but most of them healthy.	The few present quite normal.
Soluble Sulphur 3lbs. in 50 gallons	May 28	Fairly normal. A few dried up.	All dried up in the June 6 stage.
Lime Sulphur 1 in 26	June 4	Many dried up.	All dried up in the June 6 stage.

Four rows of young cider apple trees in the nursery, well separated from each other, and containing twenty-four trees per row, were experimented on. No. 1 was treated with a solution of potassium thiocarbonate at the rate of 30 gallons of water to 14 oz. of the thiocarbonate. No. 2 had injections of 24 oz. of carbon bisulphide in equal doses at about a yard distant from each other. No. 3, had a solution of carbon bisulphide containing 24 oz. in 100 gallons of water applied to the soil, and No. 4 had injection of toluene amounting to 24 oz. in one ounce doses, similar to No. 2. In none of the four cases could any sensible diminution of attack in the summer be observed. No. 1 was applied in the middle of May, and Nos. 2—4 in the middle of April.

Treatment against Wireworms.—Against wireworm many forms of treatment have been advocated, and from their number the conclusion may be drawn that none are strikingly effective. With its hard cuticle, its underground habits, and its powers of migration, the pest avoids all the usual methods of killing insects. Its voraciousness and its catholic taste make it both exceedingly harmful and difficult to control by cultural means. It is, indeed, supposed to attack every plant except mustard. The damage it does to crops planted on freshly ploughed or dug grass land is sometimes excessive, and generally great. Farmers and gardeners suffer alike.

Most of the customary preventive measures may be found in the Board of Agriculture's leaflet on the subject. It seemed desirable, however, to test under laboratory conditions some of the hitherto recommended soil insecticides and any others that could be thought of since the results can be better controlled.

The method used was as follows. Four or five wireworms were placed carefully in moist but not wet earth in beakers whose superficial area was 1-100th square yard, and whose depth was about five inches. This is admittedly an artificial method, as the larvæ cannot escape except from the top, which they never do, and the depth does not correspond to the average cultivated depth of a field.

Of the easily vapourisable liquids, oil of mustard, petrol, carbon disulphide and oil of mirbane were tried. (For results see Table I appended.) In these cases the liquid was placed at the bottom of a clean beaker then earth quickly added, filling the beaker up to three-fifths, and lastly the wireworms were laid on the earth, and more earth added till the beaker was full.

Of all the fluids tried oil of mustard proved the most deadly, and this is to be expected from the good results known to follow from digging or ploughing in a crop of mustard. It is, however, far too expensive. The other noticeable thing in the table is the failure of carbon bisulphide even at strengths which would be prohibitive

in cost. A possible explanation for this fact is ventured after the consideration of Table II, showing results from slowly volatile substances. These require some days for their complete effect, and are characterised by a slow continuous volution of poisonous vapour. Those used were vaporite, naphthalin, a mixture of lime and paraffin, and a mixture of ammonium sulphate and lime.

The mixture of ammonium sulphate and lime, which showed promise in preliminary experiments, failed to give good results. The same was the case with lime and paraffin. It would, besides, be of questionable advisability to add much paraffin to the soil owing to its very slow escape therefrom.

Vaporite at $\frac{1}{2}$ gr. per beaker, or 1 lb. per 8 square yards, a quantity recommended by the manufacturers, gave fair results ; but much better results were got by using half the weights of crude naphthalin, a result, too, obtained at about one-third of the cost.

Reviewing the whole experiment, the superiority of crude naphthalin is the most noticeable thing. Carbon disulphide gave disappointing results. In practice this material is awkward to deal with as its dangerous nature, and consequent high price through cost of carriage, is against it, and it has been found by many observers to be very capricious in action. Its failure to kill may have been due to its high volatility. Wireworms are extremely resistant to harmful influences, and they can apparently survive the vapour, if not in prolonged contact with it. No smell of it could be observed in the beaker after a day, while the naphthalin vapour could be smelt for nearly a week. It is, perhaps, owing to its slow action that naphthalin is successful. The last experiment shows that naphthalin vapour does not penetrate downwards, and must in practice be dug in fairly deeply.

At twice the strength, namely, 2 oz. per square yard, it has been tried outside. While it is exceedingly difficult to judge of the efficacy under these conditions, in the author's opinion it considerably lessened, if it did not entirely stop, attacks by the larvæ on a piece of garden land on which trials were made.

Substance.	No. of Larvæ.	Examined After.	Result.			Amount Per Sq. Yd.	Cost per Acre.
Oil of mustard			Dead.	Missing	Living.		
1 drop	5	2 days	4	1	0	1-6th oz.	£12 10 0
½ drop	4	4 days	0	1	4	1-12 oz.	£6 5 0
Carbon disulphide.							
1 drop	5	2 days	1	1	3	1-6th oz.	£2 0 0
2 drops	5	2 days	0	0	5	1-3rd oz.	£4 0 0
4 drops	4	1 day	0	0	4	⅔ oz.	£8 0 0
Petrol 4 drops	5	?	1	1	3	⅔ oz.	£2 5 0
Oil of Mirbane.							
2 drops	5	2 days	0	1	4	⅓ oz.	£0 17 0
3 drops	5	4 days	0	0	5	½ oz.	£1 5 6

Substance.	No. of Larvæ.	Examined After.	Result.			Amount Per Sq. Yd.	Cost per Acre.
			Dead.	Missing.	Living.		
Am. sulph. and fresh slaked lime ·25 gr. am. sulph. 5 gr. lime	5	2 days	2	0	3	1½ oz.	£5 0 0
·5 gr. am. sulph. 5 gr. lime	5	2 days	0	0	5	2 oz.	£6 0 0
·6 gr. am. sulph. 5 gr. lime	5	2 days	2	1	2	2¼ oz.	£6 15 0
Paraffin lime xs added	2	2 days	2	0	0		
20 gr.	4	5 days	1	0	3	72 oz.	£9 0 0
Vaporite ½ gr.	5	2 days	3	0	2	2 oz.	£2 10 0
Ditto	3	3 days	2	0	1	2 oz.	£2 10 0
Pure naphthalin ¼ gr.	4	7 days	4	0	0	1 oz.	?
Crude naphthalin ¼ gr. diluted with same quantity slaked lime	4	5 days	3	1	0	1 oz.	£0 19 0
Ditto, but larvæ placed at bottom of beaker and naph. 3-5ths up the beaker	4	4 days	0	1	3	1 oz.	£0 19 0

A NOTE ON THE RELATION BETWEEN WOOLLY APHIS AND CANKER.

By S. P. Wiltshire, B.Sc.

From many sources the information may be gleaned that attacks of canker are associated with attacks of Woolly Aphis. This fact seems to be well established by numerous observers, although it is extremely difficult to demonstrate. Woolly Aphis undoubtedly may be prevalent without canker. The exact relation between the two organisms has never been fully investigated, although Descours Desarces has shown without doubt that the insects carry the conidia about in their woolly covering.

The canker fungus, *Nectria ditissima, Tul.*, is a wound parasite; and hence it is especially necessary to examine the wound made by the aphis. The insect inserts its stylet into the bark of the tree and sucks up the sap on which it lives. In response the plant rapidly forms a soft tissue, in place of wood, which causes the stem to swell at the point attacked. Finally, the bark bursts open. In the winter the insects die off, and it not infrequently happens that the frost kills the soft tissue. Healing follows, and by such alternative killing and healing, the knobbly growth so characteristic of woolly aphis galls is produced.

The question is how infection takes place over injuries such as have been described. Numerous inoculation experiments have been made during the course of this investigation at Long Ashton on injuries made by the aphis in which the bark was not burst open. All were unsuccessful. Inoculations were made in the plantation, in bell jars in the laboratory, with or without aphis, and also by inoculating first with *Nectria* conidia, and then with the aphis. It seems quite impossible that infection can occur through the slight wounds made by the probings of the insect. In the late summer the bark is burst open and this may possibly afford an entrance, although in experiments on this point the infected portions were always excluded by a bark layer, or phellogen. The action of frost is to kill most of the soft pulpy tissue, if not all, leaving the wood exposed. Definite inoculations of these portions have not always been successful, since a small portion of the soft tissue is left covering the wood as a bark. It is most probable that the infection occurs in these later stages of the injuries rather than the earlier ones—a conclusion which is borne out by the fact that canker attack usually occurs in the year following that of the aphis.

THE INFECTION AND IMMUNITY OF THE APPLE AND PEAR SCAB FUNGI.

By S. P. Wiltshire, B.Sc.

Disease resistance is rapidly becoming one of the most important problems of horticulture. Remedial measures for the control of plant diseases are only completely satisfactory in comparatively few cases; and it is not unreasonable to expect that if more was known of infection and immunity to phenomena generally it should be possible to apply control rather more intelligently than is done at present. It will take many years, however, before any real understanding of immunity is arrived at, and if in the future such knowledge will be able to be applied to horticulture, it will only be as the result of much patient and laborious investigations. The problem of immunity is extremely intangible; but, although so unpromising at present, it is essential that an effort should be made for its solution. The difficulty is to find a satisfactory line of inquiry, for the question is so complex and so many unknown factors are involved that some may question if science has yet reached a stage sufficiently advanced for such an investigation to be profitably started. The importance of the subject, however, necessitates that every attempt should be made to add to our knowledge of this question, and however minute the information added may be, it cannot fail to be of real value.

Immunity does not depend on the absence of the disease, but on the failure of the disease to develope on a resistant host. It is useless, therefore, to begin a study of the attack of the fungus on a resistant plant until it is known what happens in the normal infection of a susceptible variety. The work briefly summarised here,* sought to discover exactly the method of infection of the fungi in question, *Venturia inæqualis und V. pirina*, (which are practically identical so far as infection is concerned), and to inquire into the sequence of events in an attack on an immune host.

The germination of the conidia of the fungi, which are produced on scabbed patches on the stems of the previous year's growth,

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* For a detailed account see the "Annual of Applied Biology," Vol. 1, Jan., 1915, p. 335.

produces the primary infection in spring from which the main infection starts. The conidia cannot germinate without being immersed in water for some time. After immersion the spore sends out a germ tube which soon broadens out into a flange-like structure, the appressorium, firmly attacking to the tube to the cuticle of the host. From the lower side of this appressorium an infection hyphæ is put out, which in the case of young organs, where the cuticle is thin, quickly reaches the outer wall of the epidermal cells. The further development of the fungus takes place between the cuticle and the epideamis. Usually mature organs are resistant to the disease. It has been found that this resistance is determined not by the cuticle but rather by some more intimate relation with the living substance of the host. In mature fruit, where the cuticle is exceptionally thick, the infection tube grows horizontally in this layer, finally dying out without causing infection. A similar growth was observed in the mature leaves of both a susceptible and resistant variety of pear inoculated with the pear scab fungus. In varieties which are rarely attacked by scab, the young leaves as well as the mature ones are resistant to the disease. The appressoria of the germinating conidium is formed in the usual way, and the infection hyphæ may penetrate the cuticle ; but no great development ever takes place. From these results it is suggested that the fungus may attack the host in spite of any adverse influence which the host may exhibit, (such as it obviously exhibits in the case of mature organs), rather than depend on some substance from the host to attract the parasite towards it.

A SPOT DISEASE OF APPLES.

By B. T. P. Barker.

During the winters of 1913 and 1914 a spot disease has been very prevalent on certain varieties of apples grown at the Institute. The disease appears mainly on the later varieties, and at the time of gathering there is generally no sign of the trouble to be observed on the fruit. The spots gradually appear after storage for some time in the fruit room. The varieties which have been most affected at Long Ashton are Allington Pippin and Bramley's Seedling. Specimens of Newton Wonder occasionally show the disease; but, generally speaking, this variety has not been seriously affected. During the last winter attention has been called to the disease by various growers in the *Gardeners' Chronicle*. Mention is there made of several varieties, in addition to those named above, which have taken the disease. My attention has also been drawn to the trouble by Mr. G. P. Berry, of the Horticultural Branch of the Board of Agriculture, who reported that in many parts of the country the outbreak had been very serious, and had rendered much fruit unmarketable. Specimens have been sent in from Herefordshire, Worcestershire, Cambridgeshire, Oxfordshire, Kent and Sussex. It must, therefore, be concluded that the disease is general this season throughout the apple growing districts in this country.

The spot first appears on the surface of the fruit as a small brownish speck, which gradually enlarges until it reaches a quarter of an inch or more in diameter. In many cases the spots remain quite small and not larger than the size of a pin's head. Occasionally the spots develop into patches of decaying tissue which extend indefinitely. There is reason to think that in these cases one of the common mould fungi, such as *Mucor* and *Penicillium*, has obtained an entry at the affected spot and caused rapid extension of the diseased area. This is evidently a secondary effect. Normally the spots do not in most cases increase in size much beyond a quarter of an inch in diameter. While the spots at first are brownish in colour, in many cases they rapidly become black. In other cases they remain the original brown colour. Towards the centre of each spot the skin

of the apple shows a break, and on this account it has been suggested that the disease might be due to punctures caused by some insect. Examination has, however, shown that the broken surface in the centre of the spot represents the external part of a structure in the superficial tissues of the fruit which appears to correspond to a lenticel.

A very similar kind of spot on apples has been reported during the last few seasons by various observers in the United States, and the name " Jonathan Spot " has been given to this disease on account of its prevalence on the Jonathan variety.

The spot also bears some superficial resemblance to the spots of bitter pit ; but there is a clear difference between the two, which can be seen on cutting open an affected apple. In bitter pit the discoloured tissue extends for some distance into the pulp. In the disease under consideration it is little more than skin deep.

Microscopical examination of the affected spots has been made, and it has been established that fungus hyphæ were present in all cases examined. The hyphæ penetrate between the cells of the outer tissues of the fruit, causing the death of those cells. The extension of the hpyhæ into the surrounding tissues does not appear to take place freely, and on that account no doubt the size of the spots generally remains limited.

Reference has been already made to the relation of the spots to the lenticel-like structures in the skin of the apple. These can be seen with the naked eye on most kinds of apples as minute spots, more or less russet-like in character, about the size of a pin prick, or slightly larger. In some varieties the presence of these structures is very noticeable : in others their presence is not so obvious. It is highly significant that the " spot " invariably makes its appearance around one of these points ; and it seems likely therefore that it is through these presumably weak points in the skin of the fruit that the hyphæ of the fungi are most easily able to penetrate.

Many cultures have been made of the fungus mycelium found in the diseased spots. When cultures are made from the spots without previous sterilisation of the surface of the fruit, species of Penicillium invariably develop in the cultures. These, however, rarely occurred when the surface of the fruit was sterilised previous to making an infection from the spot tissue. In some instances the whole of the spots examined in this way on a single apple have yielded the same fungus ; and at first it was concluded that the fungus which appeared was the form responsible for the disease generally. Further examination of different apples and of fruit from different districts has, however, shown that the particular fungus in question does not invariably occur, although it has been found in a number of specimens. Three or four other forms have been isolated from such cultures. In some cases the apples have given

one of these only, and in other cases mixtures of the various forms have been obtained. Infection experiments are now being made to determine whether all of these kinds isolated are capable of producing the characteristic spot disease, or whether one only is concerned. Until the results of these experiments are available, definite conclusions as to the cause of the disease cannot be drawn. So far, however, as the investigation has proceeded at present, the most probable explanation of the disease seems to be as follows :—

That in some seasons certain of the later varieties of apples, owing to physiological conditions of the fruit due to the character of the season are peculiarly liable to attack through the weak spots on the surface of the fruit due to the presence of "lenticels," by the hyphæ of certain fungi capable of causing local rot. Possibly only a few kinds of fungi capable of causing local rot are able to enter the fruit at such points, since some cuticular penetration seems to be required, as the cells of the underlying tissues are not absolutely exposed but are covered more or less completely with a cuticle of variable thickness. The subsequent development of the fungus is generally not extensive, possibly owing to the internal conditions of the fruit being unfavourable to its growth.

CROP RECORDS FROM THE VARIETY TRIALS OF FRUIT.

In the accompanying tables will be found details of the crop weights of individual varieties of apples, pears, plums, and small fruits grown in the first two plantations established at the Institute. Plantation No. 1 was planted in the winter of 1904–5, and Plantation No. 2 was laid down the following winter.

The first table contains the records for apples, pears and plums. The whole of the varieties in Plantation No. 1 and the apples in Plantation No. 2 have been included in a series of pruning experiments, to which reference has been made in previous reports of the National Fruit and Cider Institute. The yields, therefore, do not represent the maximum of which the varieties are capable under the best treatment; but since each variety is treated similarly, the results for the individual sorts in Plantation No. 1 and 2 respectively are comparable. The trees in Plantation No. 1 were originally planted 10 feet apart. It was found, however, in 1910, that this distance was not sufficient to allow the trees enough room for the pruning experiments to be conducted properly, and the whole were therefore lifted and planted out again at a distance of 15ft. apart. The culinary apples were lifted in the spring of 1911, and the dessert apples the following year. The pears have so far not been moved in Plantation No. 1. The trees in Plantation No. 2 still remain 10 feet apart, as originally planted. This distance does not allow them sufficient room, and each season, therefore, hard pruning is resorted to where necessary, the trees being cut back on to old wood to keep them sufficiently restricted. So far as the trials have gone at present, in Plantation No. 1 Allington Pippin, among the dessert apples, has given much the best result. Beauty of Bath has been a failure; but this result may be largely due to the kind of pruning necessitated by the pruning experiments scheme. Among the culinary varieties Newton Wonder and Bramley's Seedling are far the best. Lord Suffield was originally planted in addition to the varieties included in the table, but this variety cankered so badly that it was discarded when the other trees were transplanted. Of the pears Catillac has given very good results, and Doyenné

Boussoch has also cropped fairly well. Louise Bonne de Jersey, although doing fairly well for the first few years after planting, has steadily deteriorated, and the trees now suffer severely from pear scab each season, the crop generally being more or less ruined. In Plantation No. 2 Bismarck, Lord Grosvenor, Warner's King, Gascoyne's Scarlet Seedling, Lord Derby, Potts' Seedling, and Wellington have proved more or less satisfactory. Certain of these varieties, such as Warner's King, show signs of the future trouble owing to canker. Others, such as Wellington, are only just beginning to give good results. Among the dessert varieties James Grieve stands out conspicuously. King's Acre Pippin, Sturmer Pippin, Court Pendu Plat, Charles Ross, and Rival are all more or less satisfactory; but for the most part they are lacking in quality of flavour. Coronation, Golden Noble, and Houblon have so far proved failures. Among the pears in this plantation Conference, Dr. Jules Guyot, Pitmaston Duchess, and Bellissime d'Hiver have cropped best. The results with plums have been most unsatisfactory. Experiments are being undertaken to ascertain the cause of the poor crops. The soil is naturally deficient in lime, and possibly this may, to a large extent, account for the results.

The second table contains the records of the crops of the gooseberries and currants grown in Plantations 1 and 2 for each season since planting. In some cases the plants were removed in 1912 owing to overcrowding by the top trees among which they were interplanted. In no cases are the crop yields for 1914 given, since, for the same reason, only a few bushes of certain of the varieties had been left. These variety trials can, therefore, now be considered as ended. Owing to the fact that the whole of the bushes were interplanted with apple, pear and plum trees, and that they were regarded from the start as simply a temporary crop, the trial cannot be considered thorough or altogether fair. A certain allowance ought to be made for the different extent to which individual varieties were over-grown according to the kinds of top fruit between which they were planted. In addition, the bushes were utilised from time to time for various other experiments which, to some extent, doubtless interferred with their normal cropping; but, so far as possible, when such experiments were conducted the varieties were treated more or less alike. Certain varieties suffered very severely from the "die-back" disease, caused by the fungus *Botrytis;* but, since this may be considered to represent a variety character, no allowance for losses has been made in the results. In spite, however, of these weak points in the trials the results as a whole appear to be sufficiently decisive to allow conclusions to be drawn as to which varieties are best suited for this locality and soil. Among the gooseberries, Keepsake and Whinham's Industry are pre-eminent. King of Trumps, Telegraph, Gretna Green and Langley Gage have

also done well. Of the red currants tested, Raby Castle is the best, with New Red Dutch a good second. White Dutch proved the best of the white currants, and Ogden's Black of the black currants. The trials of the latter fruit, however, were so unsatisfactory from various causes that no great reliance can be placed on the results. In Plantation No. 1 a number of other varieties of black currants, including Carter's Champion, Black Naples, Baldwin, and Lee's Prolific were originally planted; but these were badly attacked by bud mite and a fungus disease at an early stage, and were uprooted before the trials had proceeded sufficiently far to allow any opinion to be formed as to the merits of the respective sorts.

TABLE I.

Name of Variety.				Yield in lbs. 1914.	Yield in lbs. 1906-13.
PLANTATION No. I.					
APPLES DESSERT—					
Allington Pippin	27 bushes and 3 standards	..	..	954½	992½
Beauty of Bath	.. „	..	..	59¾	57¾
Cox's Orange Pippin	„	..	..	112¼	356½
Devonshire Quarrenden	„	..	..	443¾	233¾
King of the Pippins	„	..	..	131½	749
Worcester Pearmain	„	..	..	153½	422
APPLES. CULINARY—					
Stirling Castle	27 bushels and 3 standards	..	..	243½	412¾
Newton Wonder	.. „	..	..	1442½	817
Lane's Prince Albert	„	..	..	471¼	659½
Bramley's Seedling	„	..	..	1739	651
Ecklinville	.. „	..	..	401¾	573
PEARS—					
Catillac	.. .. „	..	..	909	492½
Doyenné Boussoch	.. „	..	..	469	386
Louise Bonne de Jersey	„	..	..	72¼	255¼
Williams' Bon Chrétien	„	..	..	283	245½
PLANTATION No. II.					
APPLES—					
Bismarck	.. 7 bushes and 3 standards	..	..	350	441¾
American Mother	.. „	..	..	141	32¾
King's Acre Pippin	.. „	..	..	69½	267½
Lady Sudeley	.. „	..	..	44	84¼
Lord Grosvenor	.. „	..	..	103½	571½
Warner's King	.. „	..	..	106¼	509
White Transparent	.. „	..	..	118¼	167½
Gascoyne's Scarlet Seedling	„	..	..	372½	250½
Court Pendu Plât	10 bushes	..	..	150½	152
Frogmore Prolific	.. „ ..	..	..	71½	287¾
James Grieve	.. „ ..	..	..	114	383
Lord Derby	.. „ ..	..	..	138½	472½
Peasgood's Nonsuch	.. „ ..	..	..	25½	163½
Potts' Seedling	.. „ ..	..	..	124¼	334
Rival	.. .. „ ..	..	..	79½	186¾
Sturmer Pippin	.. „ ..	..	..	68	393¾
Wealthy	.. .. „ ..	..	..	121½	87¼
Coronation	.. .. „ ..	..	..	—	48¾
Golden Noble	.. „ ..	..	..	—	22
Lord Hindlip	.. „ ..	..	..	14¼	45¾
Royal Jubilee	.. „ ..	..	..	132½	173¾
Charles Ross	.. „ ..	..	..	24½	246¾
Wellington	.. „ ..	..	..	159¾	218½
Houblon	.. .. „ ..	..	..	—	35

TABLE I.—*continued.*

Name of Variety.	Yield in lbs. 1914.	1906-13.
PLANTATION No. II.—*continued.*		
PEARS—		
Conference .. 7 bushes and 3 standards ..	343	183¼
Dr. Jules Guyot .. „	239	186½
Hessle .. .. „	103	124
Pitmaston Duchess .. „	314	64
Bellissime d'Hiver 10 bushes	168½	116
Durondeau .. .. „	7	14
Emile d'Heyst .. „	40½	80½
Vicar of Winkfield .. „	8½	25¼
Petite Marguerite .. „	139	49
Beurré Hardy .. „	16	6
Beurré d'Amanlis .. „	135½	25¾
Triomphe de Vienne „	11	5
PLUMS—		
Denniston's Superb 7 bushes and 3 standards ..	8	23¾
Pond's Seedling .. „	75	289
Early Transparent Gage „	122	112¼
Belle de Louvain „	35½	35½
Monarch .. 10 bushes	6	13½
Heron .. .. „	12	17¾
Early Rivers .. „	19¼	30
Czar .. .. „	91	47
Mallard .. .. „	2	6½
Late Orange .. „	5	12½
Victoria .. .. „	12	58¾

TABLE II.

Name of Variety.	Yield in lbs.								
	1906	1907	1908	1909	1910	1911	1912	1913	Total.
CURRANTS.									
BLACK—									
Boskoop Giant 30 plants	—	—	—	16	56¼	27¾	6¾	—	106¾
Black Prince .. .. „ ..	—	—	—	19	15¾	19¼	21¼	—	75¼
Goliath .. .. „ ..	—	—	—	11	18	22¾	5¼	—	57
Ogden's Black .. .. „ ..	—	—	—	36½	30½	43	77	—	187
Victoria .. .. „ ..	—	—	—	16	21½	19	11½	—	68
RED—									
Fay's Prolific 90 plants	30½	126	48½	320¼	117¾	73¼	78½	—	794¾
Knight's Sweet Red .. „ ..	48	97	63	233	131¾	99¾	71¼	—	743¾
Raby Castle .. „ ..	28	92¾	126½	480	233¾	247½	203¼	—	1411½
Cherry .. 30 plants	—	—	—	10	3¾	14½	12½	15	55¾
Comet .. .. „ ..	—	—	—	14	5¼	3½	—	—	22½
La Fertile .. .. „ ..	—	—	—	12	8½	7¼	4¾	—	32½
La Hâtive .. .. „ ..	—	—	—	9	4½	10½	8¾	—	32½
La Versailles .. „ ..	—	—	—	15	8	11¾	18¾	23	76½
New Red Dutch .. „ ..	—	—	—	39	22	83¾	61	147¼	353
Red American .. „ ..	—	—	—	7	8½	29¼	—	69	113¾
Red Grape .. „ ..	—	—	—	10	2¾	8	9	30½	60¼
Moore's Seedling .. „ ..	—	—	—	—	8	7	—	40½	55½
La Transparent .. „ ..	—	—	—	35	8¼	11¼	—	5½	60
Red Cross .. .. „ ..	—	—	—	—	—	—	27½	—	27½
WHITE—									
White Dutch 90 plants	1 3	155	92	545	31½	50	14	—	990½
White Dutch Cut Leaf 30 plants	—	—	—	36	5	10¾	5	—	56¾
White Transparent „ ..	—	—	—	27	10	18¼	9	33	97¼
White Versailles .. „ ..	—	—	—	24	14	16½	5	6	65½

TABLE II.—*continued.*

Name of Variety.	Yield in lbs.								
	1906	1907	1908	1909	1910	1911	1912	1913	Total.
GOOSEBERRIES—									
Crown Bob 90 plants	40½	197	50¼	511	104½	126	27½	—	1056¾
Keepsake .. „ ..	70	313½	177¼	734¾	418	315¾	438½	—	2467¾
Lancashire Lad .. „ ..	50	141	192	341½	333¾	383¼	181½	—	1623
Whinham's Industry „ ..	69	133	183½	745½	592½	722	400	—	2845½
Blucher 20 plants	—	6½	2½	15½	9	15	20	54½	123
Careless .. .. „ ..	—	22¼	34	41	86	34	50½	44	311¾
Early Sulphur .. „ ..	—	—	7½	30¾	11	52½	100	36½	238¼
Faithful .. .. „ ..	—	12¾	19	57	53¼	53¾	50	22	267¾
Falstaff .. .. „ ..	—	8¼	16	38½	21½	52	77	37	250¼
Fascination .. „ ..	—	22¼	27¼	47	72	53½	41½	11¾	275¼
King of Trumps .. „ ..	—	27½	16	119	153¼	79¼	124	82½	601½
Leader .. .. „ ..	—	16¾	7¾	33½	76¾	32¼	96	45½	308½
Leveller .. .. „ ..	—	24¾	36¼	49½	61½	15¼	—	10½	197¾
May Duke .. „ ..	—	7½	3½	83½	14	58½	104½	—	271
Mount Pleasant .. „ ..	—	4½	9¾	32¾	45½	16½	5½	30¼	144¾
Red Warrington .. „ ..	—	10	6¾	70¾	24½	57	85	84	338
Surprise .. .. „ ..	—	25	28½	55¼	66½	69¾	67	22¼	334¼
Telegraph .. .. „ ..	—	17¾	14¾	60½	127¼	75¾	125¾	36½	458¼
Golden Gem 10 bushes	—	5¼	5	11½	10¼	29¼	7	15	83¼
Gretna Green .. „ ..	—	6¼	7¼	29	31¾	69⅛	68¼	40	252
Dan's Mistake .. „ ..	—	—	—	11	10	20½	—	31¼	72¾
Diadem .. .. „ ..	—	8¼	5¾	20¼	69½	40½	43	—	187¼
High Sheriff .. „ ..	—	3½	4¾	7¼	30½	2	8¼	8½	64¾
Hero of the Nile .. „ ..	—	2¼	3¾	6¾	5½	5¾	19	11½	54½
Langley Gage .. „ ..	—	5¼	4	61¾	60½	8½	98	33½	271½
Ringer .. .. „ ..	—	3½	2¼	8¾	14	24¾	3¾	5¾	62¾
Thatcher .. .. „ ..	—	5¾	7	17	20	25	14	—	88¾
Victoria .. .. „ ..	—	6	1	33	31	36¼	30½	41½	179¼
Red Champagne .. „ ..	—	2	3½	23¾	14	27½	35	23	128¾
Transparent .. „ ..	—	—	6¾	19	63¾	23½	5	—	118

THE TIME OF BLOSSOMING OF FRUIT TREES.

In accordance with the usual practice in these Reports the records of the flowering dates of individual varieties of fruit trees grown in the plantations and orchards of the Institute are given below. The following remarks indicate the main features of interest presented by the records for 1914.

As regards apples, the date of blossoming was in most cases considerably earlier than in 1913, and also than the average. Since 1908, when the records were first kept, the only season approaching that of 1914 for earliness was 1912. Taken as a whole, the market varieties blossomed in approximately the same general order as usual, Royal Jubilee and Court Pendu Plât being the two varieties which most regularly come into blossom latest. With regard to earliness of flowering, White Transparent may be mentioned as being regularly among the first varieties to flower, Beauty of Bath and Bismarck also coming into blossom regularly at about the same period.

Records are given of a large number of vintage varieties, some of which are grown on the Paradise root stock and others on the free stock. In a limited number of cases the same variety has been grown on both types of root stock, and the records in such cases have particular interest on account of their bearing on the question of root stock influence on the time of blossoming. It was stated in last year's report that in such instances, although the dates of blossoming did not always coincide, there was, nevertheless, little difference between the dates in the two cases, and the conclusion was drawn that root stock influence in this direction was not important. It is, perhaps, desirable to qualify this statement somewhat in view of recent results in connection with the work on types of root stocks referred to in another section of this Report. A number of strains of Paradise stock have been collected, and although in most cases the time of bursting of the buds of the different strains varies but little and does not differ greatly from that of the majority of free stocks, nevertheless, in one or two cases a particularly early variety has been found. In the case of the

vintage varieties under consideration, all were worked on one particular strain of Paradise stock, this strain beginning to show growth about the same period as the average free stock. It is, perhaps, therefore to be expected that in such cases very little difference in the date of blossoming of the varieties on such stocks would be observed. It is possible, however, that, if one of the earlier types of Paradise stock had been used instead, the flowering of the worked variety might have been appreciably earlier. That point will be settled in due course, when the root stock experiment scheme is further advanced.

Considering individual vintage varieties, the records follow more or less the same lines as those of market varieties. One variety, Médaille d'Or, may be referred to as of particular interest on account of its extreme lateness of blossoming. In nearly every season the trees of this sort are in an almost dormant condition while most of the other varieties are in full blossom, and although an occasional blossom may open at a date not very far removed from that of other late flowering varieties, the majority of blossoms are generally far behind those of all other kinds of apples grown at the Institute.

The flowering dates for pears and plums were as a whole appreciably later than in 1913 and 1912. Among the pears Louise Bonne de Jersey is regularly among the first to open. Vicar of Winkfield, Beurré d'Amanlis and Beurré Clairgeau are also among the earliest, although the two latter were later than usual in 1914. Dr. Jules Guyot, Hessle, Catillac and Pitmaston Duchess constitute the latest blossoming class. The vintage varieties of pears as a whole are distinctly later in flowering than the market varieties. Possibly the fact that the former have been grown on the pear stock and the majority of the latter on the quince stock may have something to do with this feature.

Among the plums, Mallard stands by itself as the earliest blossoming variety, and Kirke's is the latest.

In the case of the small fruits, individual varieties of raspberries and strawberries show comparatively small differences except in the case of a few of the later ripening strawberries, such as Givon's Late Prolific and Laxton's Latest. Black currants also do not differ greatly according to variety. Red and white currants and gooseberries on the other hand show relatively large differences in the case of individual kinds, there being a gap of three weeks between the first and last blossoming sorts.

The following tables, drawn up by Mr. Coombes, contain the individual results for each year since 1908 in which records were obtained.

Variety.	Date of Flowering.						
	1914	1913	1912	1911	1910	1909	1908
APPLES.							
Market Varieties							
Bismarck	Apl. 20	Apl. 23	Apl. 20	May 4	May 2	May 7	
Warner's King ..	,, 20	,, 22	,, 20	,, 5	Apl. 30	,, 5	
White Transparent ..	,, 20	,, 20	,, 20	,, 5	May 2	,, 7	May 11
James Grieve ..	,, 20	May 3	,, 20	,, 6	,, 6	,, 5	,, 13
Sturmer Pippin ..	,, 20	Apl. 22	,, 22	,, 8	,, 4	,, 5	,, 9
Beauty of Bath ..	,, 20	,, 18	,, 20	,, 5	,, 4	,, 7	,, 6
Lord Hindlip ..	,, 20	May 5	,, 20	,, 6	,, 7	,, 8	
King of the Pippins ..	,, 21	Apl. 30	,, 21	,, 8	,, 8	,, 6	,, 12
Lady Sudeley ..	,, 22	May 9	,, 28	,, 9	,, 18	,, 9	,, 14
Houblon	,, 22	,, 7	,, 25	,, 10	,, 13	,, 8	
Devonshire Quarrenden	,, 22	Apl. 19	,, 20	,, 5	,, 4	,, 7	,, 6
Rival	,, 22	May 6	,, 22	,, 10	,, 7	,, 11	
Allington Pippin ..	,, 22	Apl. 28	,, 22	,, 4	,, 12	,, 7	
Lord Suffield ..	,, 22	May 1	,, 13	,, 8	Apl. 29	,, 9	,, 10
Ecklinville	,, 22	Apl. 28	,, 19	,, 8	May 4	,, 7	,, 11
Stirling Castle ..	,, 22	,, 28	,, 15	,, 7	Apl. 29	,, 6	,, 5
Newton Wonder ..	,, 22	May 10	,, 24	,, 8	May 9	,, 9	
Bramley's Seedling ..	,, 22	,, 7	,, 19	,, 7	,, 10	,, 5	,, 1
Frogmore Prolific ..	,, 23	,, 7	,, 24	,, 9	,, 8	,, 9	
Gascoyne's Scarlet Seedling ..	,, 23	,, 13	,, 25		,, 12	,, 11	
Peasgood's Nonsuch ..	,, 24	,, 7	,, 21	,, 8	,, 3	,, 10	
Wellington	,, 24	,, 7	,, 24	,, 10	,, 14	,, 10	
Lord Derby ..	,, 24	,, 3	,, 25	,, 10	,, 12	,, 10	
Potts' Seedling ..	,, 24	,, 1	,, 25	,, 9	,, 5	,, 10	
Wealthy	,, 24	Apl. 28	,, 22	,, 8	,, 1	,, 9	,, 12
Cox's Orange Pippin	,, 25	,, 28	,, 27	,, 9	,, 9	,, 9	,, 11
Worcester Pearmain	,, 25	May 6	,, 22	,, 7	,, 4	,, 7	,, 11
Lord Grosvenor ..	,, 25	,, 1	,, 25	,, 9	,, 4	,, 9	
Dartmouth Crab ..	,, 25		,, 22	,, 8	,, 8		
Lane's Prince Albert	,, 25	,, 11	,, 15	,, 10	,, 8	,, 11	,, 11
Blenheim Orange ..	,, 29	Apl. 28	,, 29	,, 8	,, 12	,, 7	
Golden Noble ..	,, 29	May 13	,, 29	,, 10	,, 17	,, 14	
Charles Ross ..	,, 29	Apl. 28	,, 22	,, 8	,, 7	,, 7	
The Queen		May 2	,, 24				
American Mother ..	,, 29	,, 16	,, 29	,, 10	,, 21	,, 9	
Court Pendu Plât ..	,, 29	,, 24	May 9	,, 15	,, 24	,, 14	
Coronation	,, 29	,, 7	Apl. 25	,, 15	,, 19	,, 14	
Royal Jubilee ..	May 2	,, 18	May 1	,, 14	,, 18	,, 14	,, 27
Vintage Varieties (on the Paradise Stock).							
Fertile de Caen ..	Apl. 19						
Jarrow Bank ..	,, 21	Apl. 21			,, 3	,, 9	
Wine Sour	,, 21	,, 25	,, 3				
Broadleaf Norman ..	,, 21	May27	Apl. 29			,, 10	
Cap of Liberty ..	,, 21	,, 7	,, 27	,, 13		May 8	
No. 127	,, 21						
Tardive Forestier ..	,, 22		,, 28	,, 13		,, 8	
M. Jacques No. 2 ..	,, 22	,, 28	May 2			,, 13	
Fréquin Rouge ..	,, 22	,, 7		,, 11	,, 4	,, 8	

Variety.	Date of Flowering.						
	1914	1913	1912	1911	1910	1909	1908
APPLES (Vintage Varieties on the Paradise Stock)—*continued*							
Knotted Kernel ..	Apl. 22	May 17	Apl. 29	May 12		May 13	
No. 42	,, 22	,, 12		,, 12		,, 11	
Pride of Australia ..	,, 22	Apl. 24			May 3	,, 9	
Stuart's Seedling ..	,, 24						
No. 61	,, 25	May 12				,, 10	
Eggleton Styre ..	,, 26	,, 7	,, 29			,, 9	
Kingston Black ..	,, 26	,, 13	,, 30	,, 17		,, 11	
Frqéuin Audièvre ..	,, 27	,, 16	May 13	,, 23	,, 17		
Victoria	,, 28	,, 7	Apl. 28	,, 11		,, 9	
Cherry Pearmain ..	,, 28	,, 8	May 5				
Argile Grise	,, 28	,, 21	,, 6			,, 9	
Taylor's Spie ..	,, 29		,, 4	,, 16		,, 12	
Footlands No. 2 ..	,, 29	,, 17	Apl. 30	,, 16		,, 12	
Roussie	,, 29	,, 10	May 4	,, 12		,, 10	
Dymock Red ..	,, 29	,, 5		,, 11	,, 14	,, 9	May 22
Cowarne Red	,, 29	,, 13		,, 11	,, 16	,, 11	
Dabinett	,, 29	,, 16	,, 6	,, 16	,, 15	,, 13	,, 22
Bramtot	,, 29	,, 13	Apl. 30	,, 10		,, 11	
Fillbarrel	,, 29						
White Norman ..	,, 29	,, 17	,, 28	,, 12		,, 13	
Reinette Obry ..	,, 29	,, 12	May 1	,, 12		,, 9	
Woolston Spice ..	,, 29	,, 17		,, 16		,, 11	
Red Foxwhelp ..	,, 29	,, 17		,, 16		,, 11	
Cummy Norman ..	,, 29	,, 11		,, 11		,, 11	
Cremière	,, 29	,, 11	Apl. 29	,, 10		,, 12	
Red Streak	,, 30	,, 13		,, 13	,, 17	,, 9	
Court Royal ..	,, 30	,, 22				,, 9	
Sweet Alford ..	,, 30	,, 13	May 6	,, 11	,, 13	,, 11	
Doux Amer	,, 30	,, 17	Apl. 30	,, 12		,, 10	
Skyrme's Kernel ..	,, 30	,, 17				,, 10	
Écarlatine	,, 30	,, 10	,, 29			,, 8	
Kingston Black Improved	,, 30	,, 13	,, 30	,, 12	,, 17	,, 11	
Red Streak (Somerset)	,, 30	,, 13		,, 12			
Kingston Seymour ..	,, 30	,, 12				,, 11	
Red Manse		,, 10		,, 13			
Magg's Seedling ..		,, 10	May 3	,, 3	,, 12	,, 9	
Amie de Berthivise ..	,, 30	,, 28				,, 9	
Royal Jersey ..	,, 30	,, 31	,, 7	,, 14	,, 22	,, 10	,, 6
William Anderson ..	,, 30	,, 13				,, 11	
Sandford Jersey ..	May 1	,, 28	,, 7	,, 13		,, 13	
Rouge de Treves ..	,, 1	,, 16	,, 4	,, 12		,, 9	
Bealy Down Pippin ..	,, 1	,, 14	Apl. 28			,, 8	
Neverblight ..	,, 1	,, 13	,, 30			,, 11	
Major	,, 2	,, 16		,, 12	,, 20	,, 13	
Hardwick	,, 2		,, 28			,, 9	
The Bell	,, 3	,, 17	,, 27			,, 13	
Yarlington Mill ..	,, 3	,, 17		,, 16	,, 17	,, 13	
Northwood	,, 3	,, 17				,, 11	
Silver Cup	,, 4	,, 13		,, 12		,, 11	
Sweet Coppin ..	,, 4	,, 13	,, 30		,, 15	,, 11	
Thomas Hunt ..	,, 4	,, 17	May 4	,, 11	,, 17	,, 11	

Variety.	Date of Flowering.						
	1914	1913	1912	1911	1910	1909	1908
APPLES (Vintage Varieties on the Paradise Stock)—*continued*							
Philip Norman ..	May 4	May 16		May 18		May 13	
Bedminster	,, 4	,, 26				,, 13	
Pole Carew	,, 4						
M. Jacques No. 1 ..	,, 4	,, 18	May 6			,, 8	
Chevalier	,, 4	,, 18		,, 14	May 16	,, 17	
Cherry Norman ..	,, 4	,, 27					
Royal Jersey (Croft's)	,, 5	,, 19		,, 12	,, 30	,, 15	May 22
White Jersey ..	,, 5	,, 19		,, 13	,, 20	,, 10	
Strawberry Norman	,, 6	,, 28		,, 17		,, 18	
Broadleaf Jersey ..	,, 6					,, 9	
Harry Masters ..	,, 6	,, 22				,, 18	
Chisel Jersey ..	,, 6					,, 11	
Woodbine		,, 13	Apl. 30			,, 11	
Chiffers		,, 13				,, 10	
Médaille d'Or ..	,, 10	,, 15		,, 17	,, 22	,, 18	,, 31
Sharpe's Summer ..		,, 15				,, 10	
Fair Maid of Devon ..		,, 16	May 1			,, 10	
Glory of the West ..		,, 17				,, 10	
White Styre ..		,, 17				,, 11	
Sweet Bay		,, 17					
King		,, 18				,, 10	
Yeovil Sour		,, 18				,, 13	
Hartisman		,, 18					
White Close Pippin ..		,, 21			,, 9		
Royal Wilding ..		,, 22		,, 13	,, 19	,, 13	
Dove		,, 22	,, 4		,, 23	,, 9	
Pytheres		,, 22	Apl. 30			,, 13	
No. 32		,, 22				,, 9	
Brown Jersey ..		,, 23		,, 11		,, 15	
Dove Seedling ..		,, 23					
Virgin Mary		,, 23					
Horners		.. 23					
Bèdans des Parts ..		,, 26		,, 17		,, 13	
Vignons		,, 28				,, 9	
Improved Pound ..			,, 29	,, 12		,, 10	
Osborn's Cadbury ..			,, 16				
Umbrella	Apl. 26		,, 18			,, 10	
Porter's Perfection ..	May 1	,, 1	May 1				
Davis Crab						,, 8	
Rouge Bruyère ..		,, 26				,, 9	
Smyth Osbourne's No. 7		,, 5					
Little Mother ..						,, 10	
VINTAGE VARIETIES (on the Free Stock).							
Pride of Australia ..	Apl. 22	Apl. 21		,, 9		,, 8	
Tardive Forestier ..	,, 22	May 1	,, 21				
White Jersey ..	,, 22		,, 5	,, 14	,, 17	,, 23	,, 25
Court Royal	,, 23	,, 7	,, 23	,, 8	,, 6	,, 11	,,
Rouge Bruyère ..	,, 23						

Variety.	Date of Flowering.						
	1914	1913	1912	1911	1910	1909	1908
APPLES (Vintage Varieties on the Free Stock) *continued.*							
Cap of Liberty ..	Apl. 23	May 5	Apl. 23	May 7	May 9	May11	May 14
M. Jacques No. 2 ..	„ 23			„ 7	„ 5	„ 10	
Écarlatine	„ 23	„ 10	„ 18	„ 10	„ 9	„ 12	
Eggleton Styre ..	„ 23	„ 3	„ 21				
Broadleaf Jersey ..	„ 24	„ 16	May 6	„ 17		„ 14	„ 23
Rouge de Trèves ..	„ 24	„ 21	Apl. 24				
Kingston Black ..	„ 26	„ 14	May 2	„ 12	„ 14	„ 17	„ 20
Knotted Kernel ..	„ 26	„ 8	Apl. 23	„ 9	„ 5	„ 11	„ 12
Cherry Pearmain ..	„ 27	„ 7	„ 28	„ 12	„ 11		
Chisel Jersey ..	„ 27	„ 14	May 3	„ 9	„ 9	„ 11	„ 17
Early Cider Pearmain	„ 27						
Cowarne Red.. ..	„ 27	„ 15	„ 4	„ 13	„ 14	„ 17	„ 21
Butleigh No. 14 ..	„ 28		Apl. 21				
Dabinett	„ 28	„ 15	May 5	„ 12	„ 14	„ 17	„ 22
Roussie	„ 28						
Royal Jersey (Butleigh)	„ 28		„ 28				
Reinette Obry ..	„ 28	„ 14	„ 24	„ 13	„ 14	„ 17	„ 20
Red Manse	„ 28						
Doux Amer	„ 28	„ 15	„ 5	„ 12	„ 17	„ 12	„ 22
Dymock Red ..	„ 28	„ 5	„ 4	„ 9	„ 9	„ 11	„ 24
Sweet Alford ..	„ 29	„ 15	„ 4	„ 12	„ 14	„ 19	„ 22
Taylor's Bitter ..	„ 29						
Fillbarrel	„ 29						
Bramtôt	„ 29		Apl. 25	„ 15	„ 14		
Broadleaf Norman ..	„ 29		May 5				
Harry Masters ..	„ 29	„ 26	„ 6	„ 17	„ 20	„ 20	„ 31
Strawberry Norman	„ 29	„ 26	„ 4	„ 19	„ 21	„ 19	„ 8
Cherry Norman ..	„ 29	„ 24	Apl. 30				
Skyrme's Kernel ..	„ 30	„ 23	„ 30	„ 13	„ 15	„ 19	„ 22
Royal Jersey ..	„ 30	„ 18	May 4	„ 13	„ 19	„ 23	
Bédans des Parts ..	„ 30	„ 21	„ 4	„ 20	„ 17	„ 12	„ 31
Fréquin Audièvre ..	„ 30						
Cremière	„ 30	„ 12	„ 24	„ 12	„ 12	„ 13	„ 24
White Alphington ..	May 1		„ 6				
Pole Carew	„ 4						
Sandford Jersey ..	„ 4		„ 7				
Sweet Coppin ..	„ 4		„ 6				
Silver Cup	„ 4						
Major	„ 5		„ 7				
Médaille d'Or ..	„ 7	„ 29	„ 30	„ 18	„ 10	„ 20	„ 31
Foxwhelp		„ 15		„ 11	„ 9		
Fertile de Caen ..		Apl. 25	Apl. 19				
Stubbard		May 6	„ 22				
Neverblight ..		„ 14	May 3				
Maggs' Seedling ..		„ 16	Apl. 25	„ 10		„ 11	„ 22
Wesleyan		June 9					
Jones' Seedling ..			„ 21	„ 9	„ 8	„ 10	„ 18
Sharp's Midsummer			„ 25	„ 12	„ 9		
Stuart's Seedling ..			„ 22	„ 11	„ 9	„ 11	„ 26
Yarlington Mill ..			„ 25	„ 15	„ 14		
Oakham Green ..			„ 30				

Variety.	Date of Flowering.						
	1914	1913	1912	1911	1910	1909	1908
PEARS. (Market Varieties.)							
Vicar of Winkfield ..	Apl. 4	Mar. 31	Apl. 1	Apl. 21	Apl. 13		
Louise Bonne de Jersey	,, 4	,, 29	Mar. 25	,, 13	,, 3		
Bellissime d'Hiver ..	,, 5	Apl. 4	Apl. 2	,, 29	,, 13	Apl. 26	May 1
Doyenné Boussoch ..	,, 6	Mar. 30	,, 6	,, 22	,, 13	,, 24	Apl. 28
Conference	,, 6	,, 31	,, 2	,, 20	,, 15	May 1	
Emile d'Heyst ..	,, 6	Apl. 4	,, 9	,, 19	,, 15	Apl. 28	May 1
Beurré Hardy ..	,, 7	,, 18	,, 9				
Beurré d'Amanlis ..	,, 7	Mar. 16	Mar. 29	,, 21	,, 13	,, 28	,, 1
Durondeau	,, 7	Apl. 2	Apl. 1	,, 27	,, 24	,, 26	,, 1
Williams' BonChrétien	,, 13	,, 10	,, 9	,, 21	,, 14	,, 28	Apl. 30
Petite Marguerite ..	,, 13	,, 9	,, 6	,, 25	,, 23	May 1	
Triomphe de Vienne..	,, 14	,, 12	,, 13		,, 25	,, 4	
Beurré Clairgeau ..	,, 15	Mar. 25	Mar. 29	,, 21	,, 13	Apl. 28	May 1
Dr. Jules Guyot ..	,, 15	,, 31	Apl. 13	,, 26	,, 18	May 3	,, 3
Catillac	,, 15	,, 31	,, 8	,, 29	,, 22	,, 3	,, 3
Hessle..	,, 15	Apl. 13	,, 10	,, 29	,, 21	,, 3	
Pitmaston Duchess ..	,, 15	,, 12	,, 13	,, 28	,, 21	Apl. 28	Apl. 30
(Vintage Varieties.)							
Moorcroft	,, 12	,, 21	,, 7	May 3	May 1	,, 30	May 3
Taynton Squash ..	,, 14	,, 14	,, 8	,, 4	Apl. 30	,, 30	,, 3
Pine	,, 14						
J. Amphlett	,, 15	,, 26	,, 15				
Port	,, 17						
Barland	,, 19	,, 25	,, 18	,, 4	,, 30		
Oldfield	,, 20	,, 21	,, 13	,, 3	May 1	May 5	,, 3
Barnet	,, 20	,, 14					
Blakeney Red ..	,, 20	,, 21					
PLUMS.							
Mallard	Mar. 29	Mar. 7	Mar. 20	Apl. 3	Apl. 10	Apl. 17	Apl. 19
Grand Duke	,, 30						
Monarch	,, 31	,, 18	,, 22	,, 14	,, 15	,, 17	,, 30
Early Transparent Gage	Apl. 1	Apl. 2	,, 26	,, 19	,, 20	,, 22	,, 30
Denniston's Superb ..	,, 2	,, 1	,, 25	,, 19	,, 20	,, 20	,, 30
Heron	,, 3	Mar. 29	,, 24	,, 17	,, 15	,, 18	
President	,, 4	Apl. 1	,, 26	,, 20	,, 23	,, 28	May 1
Late Orange	,, 4	Mar. 29	,, 23	,, 19	,, 25	,, 19	
Jefferson	,, 4	,, 29	,, 22	,, 14		,, 17	
Goliath	,, 4	Apl. 2	,, 31	,, 25			
Czar	,, 4	,, 4	,, 30	,, 21	,, 17	,, 23	Apl. 30
Early Prolific ..	,, 4	,, 1	,, 27	,, 18	,, 20	,, 22	,, 29
July Green Gage ..	,, 5	,, 2					
Victoria	,, 5	,, 2	,, 29	,, 19	,, 19	,, 22	May 1
Belle de Louvain ..	,, 5	,, 4	,, 28	,, 24		,, 26	
Pond's Seedling ..	,, 6	,, 3	,, 31	,, 23	,, 27	,, 26	
Kirke's	,, 6	,, 18	Apl. 3			,, 26	
Comte d'Althan's Gage	,, 6	,, 5				,, 26	

Variety.	Date of Flowering.						
	1914	1913	1912	1911	1910	1909	1908
RASPBERRIES.							
Alexandra	May 12						
Penwill's Champion	.. 12						
Devon	.. 13						
Belle de Fonteney ..	.. 13						
Lord Beaconsfield ..	.. 14		May 4	May 26	May 25	May 26	
Steel's Victoria ..	.. 14						
Red Profusion ..	.. 14						
German Everbearing	.. 14						
Surpasse Falstolf ..	.. 14						
Princess Alice ..	.. 14						
Abundance	.. 15		.. 1	.. 25	.. 25	.. 28	
Carter's Prolific ..	.. 15		.. 9	.. 31		.. 27	
Bath's Perfection ..	.. 15						
Wisbech Perfection ..	.. 15						
McLaren's Prolific ..	.. 15						
Surpasse Merveille Rouge	.. 15						
Hailshamberry ..	.. 15						
Red Antwerp ..			.. 7	.. 24	.. 25	.. 28	
Baumforth's Seedling			.. 11	.. 26	.. 24		
Semper Fidelis ..			.. 5	.. 27	.. 25	.. 28	
WhiteMagnumBonum				.. 25		.. 26	
Yellow Antwerp ..				.. 24		.. 26	
Hornet		May 22	.. 12				
Northumberland Fill-basket		.. 24	.. 5				
Norwich Wonder ..	.. 15	.. 24	.. 9				
Superlative	.. 17	.. 22	.. 4				
STRAWBERRIES.							
Gunton Park ..	Apl. 23	.. 17					
Tuckwood's Early ..	.. 23	.. 17					
King of the Earlies ..	.. 23	.. 17					
Empress of India ..	.. 24	.. 17					
George Monro ..	.. 24	.. 19					
Dr. Morère	.. 24	.. 17					
Progress	.. 25	.. 18	Apl. 29				
Auguste Nicaise ..	.. 25	.. 7	.. 28	.. 11	.. 9	.. 11	
Sir Charles Napier ..	.. 25	.. 17	.. 22	.. 10	.. 13	.. 11	
St. Joseph	.. 25	.. 16	May 5	.. 10	.. 13	.. 11	
British Queen ..	.. 25	.. 17	.. 5	.. 17	.. 16	.. 17	
Kentish Favourite ..	.. 26	.. 17					
La Grosse Sucrée ..	.. 26	.. 14	.. 5		.. 9	.. 11	
Vicomtesse H. de Thury	.. 26	.. 17					
Queen of Denmark ..	.. 26	.. 13	.. 3	.. 12	.. 16	.. 14	
Keen's Seedling ..	.. 26	.. 7	.. 5	.. 11	.. 9	.. 11	
Louis Gauthier ..	.. 26	.. 15	Apl. 28	.. 11	.. 18	.. 9	
Connoisseur	.. 27	.. 17	.. 28				
Sir Joseph Paxton ..	.. 27	.. 15	May 5			.. 17	
St. Antoine de Padoue	.. 27	.. 15	.. 3	.. 11	.. 9	.. 12	
Royal Sovereign ..	.. 27	.. 14	Apl. 30	.. 9	.. 14	.. 12	
President	.. 27						

Variety.	Date of Flowering.						
	1914	1913	1912	1911	1910	1909	1908
. STRAWBERRIES *continued*..							
Laxton's Latest ..	Apl. 27						
Reliance	,, 27	May 15					
Laxton's Fillbasket ..	,, 28	,, 17	Apl. 5	May 15		May 21	
Scarlet Queen ..	,, 28	,, 17	,, 28	,, 10	May 16	,, 13	
Reward	,, 28	,, 18	,, 28				
Profit	,, 28	,, 20	,, 27				
Elton Pine	,, 29	,, 17	May 6	,, 16		,, 23	
Cropper	,, 29	,, 18	Apl. 28				
The Bedford ..	,, 29	,, 17	,, 27				
The Earl	,, 30	,, 27					
King George ..	,, 30	,, 26					
The Queen	,, 30	,, 26					
Maincrop	May 1	,, 27					
Unique	,, 4	,, 15					
Count	,, 5						
Givon's Late Prolific	,, 5	,, 22				,, 21	
Latest 1904	,, 5	,, 28					
Utility	,, 5	,, 24					
New Epicure ..	,, 5	,, 26					
Leader		,, 8	,, 22	,, 10	,, 10	,, 14	
President Loubet ..		,, 8	May 7	,, 18	,, 23	,, 20	
Trafalgar		,, 8	,, 5	,, 17	,, 20	,, 17	
Dr. Hogg		,, 15	,, 4	,, 16	,, 15	,, 14	
Bedford Champion ..		,, 18				,, 13	
New Pine		,, 18					
New Pine Apple ..		,, 20	Apl. 27				
The Laxton							
(Royal Sovereign Trials.)							
King's Acre	Apl. 25	,, 17					
Backhouse	,, 26	,, 14					
Clarke..	,, 26	,, 16					
Merryweather ..	,, 26	,, 17					
Le Cornu	,, 26	,, 19					
Hillier..	,, 26	,, 17					
Bunyard	,, 27	,, 16					
Daniels	,, 28	,, 20					
Barbier	,, 29	,, 18					
Wiseman	,, 29	,, 19					
Pyne	,, 29	,, 18					
Drummond	,, 29	,, 20					
BLACK CURRANTS.							
Baldwins	,, 12						
Black Prince ..	,, 13	,, 12	,, 27	Apl. 26	Apl. 24	Apl. 27	
Boskoop Giant ..	,, 14	Apl. 29	,, 20	,, 27	,, 27	,, 30	
Carter's Champion ..	,, 15						
Black Naples ..	,, 16						
Ogden's Black ..	,, 16	,, 28	,, 22	,, 30	,, 24	,, 30	
Goliath	,, 17	,, 29	,, 22	,, 24	,, 24	,, 29	
Victoria	,, 17	,, 28	,, 20	,, 26	,, 28	,, 29	
French (Merveille de Gironde).. ..	,, 17						
Lee's							

Variety.	Date of Flowering.						
	1914	1913	1912	1911	1910	1909	1908
RED CURRANTS.							
Wilder	Mar. 28	Apl. 8	Mar. 28	Apl. 22			
Comet	Apl. 4	Mar. 29	,, 27	,, 24			
La Transparent	,, 4	,, 31	,, 27	,, 27			
La Versailles	,, 5	Apl. 4	,, 28	,, 23			
Fay's Prolific	,, 6	,, 1	,, 21	,, 22			
La Fertile	,, 6	,, 4	,, 28	,, 24			
La Hâtive	,, 6	,, 8	Apl. 2	,, 29			
Knight's Sweet Red	,, 10	,, 2	Mar. 28	,, 23			
Cherry	,, 12	,, 31	,, 27	,, 23			
Red Cross	,, 12	,, 10	Apl. 1	May 1			
Red Grape	,, 13	,, 12	,, 11				
Moore's Seedling	,, 14	,, 21	,, 5				
Red American	,, 16	May 1	,, 13				
New Red Dutch	,, 18	Apl. 12	,, 17	,, 1			
Raby Castle		,, 19	,, 17	,, 7			
Wentworth Leviathan		,, 21	,, 5	,, 2			
WHITE CURRANTS.							
German White	Mar. 28	Apl. 7	Mar. 27	Apl. 24			
White Versaillese	Apl. 4	Mar. 31	Apl. 27	,, 27			
White Dutch Cut Leaved	,, 16	Apl. 4	,, 1	,, 25			
White Transparent	,, 18	,, 4	,, 6	,, 27			
White Dutch			,, 1	,, 22			
GOOSEBERRIES.							
Keepsake	Mar. 17	Mar. 31	Mar. 22	Mar. 27			
Langley Gage	,, 17	,, 31	,, 21	,, 27			
Lancashire Lad	,, 25	Apl. 1	,, 25	,, 13			
Whinham's Industry	,, 26	,, 31	,, 22	Apl. 2			
Crown Bob	,, 26	,, 31	,, 22	,, 2			
King of Trumps	,, 27	,, 31	,, 22	Mar. 30			
Gretna Green	,, 27	,, 4	,, 25	Apl. 12			
Red Champagne	,, 29	Mar. 31	,, 24	,, 15			
Red Warrington	,, 29	,, 31	,, 22	,, 10			
Mount Pleasant	,, 30	,, 31	,, 22	,, 2			
May Duke	,, 30	,, 31	,, 22	,, 2			
Blucher	,, 30	Apl. 4	,, 25	,, 14			
Early Sulphur	Apl. 3	,, 4	,, 25	,, 10			
Golden Gem	,, 4	,, 4	,, 23	,, 15			
Faithful	,, 4	,, 9	,, 26	,, 15			
Leveller	,, 4	,, 8	Apl. 6	,, 16			
Ringer	,, 4	,, 4	Mar. 26	,, 19			
Surprise	,, 4	,, 4	,, 25	,, 21			
Leader	,, 5	,, 4	Apl. 4	,, 20			
Telegraph	,, 5	,, 4	,, 25	,, 8			
Dan's Mistake	,, 5	,, 4	,, 30	,, 17			
Victoria	,, 5	Mar. 31	,, 27	,, 14			
Careless	,, 5	Apl. 12	,, 28	,, 14			
Falstaff	,, 6	,, 4	,, 26	,, 15			
Diadem	,, 6	,, 9	,, 29	,, 16			
Hero of the Nile	,, 6	,, 9	,, 27	,, 17			
Fascination	,, 6	,, 4	,, 27	,, 17			
High Sheriff	,, 6	,, 12	Mar. 25	,, 8			
Thatcher	,, 6	,, 12	Apl. 6	,, 18			
Whitesmith	,, 6						
Transparent	,, 9	,, 10	,, 5	,, 18			

STOCK INFLUENCE UPON VINTAGE QUALITY AND OTHER CHARACTERS OF APPLES.

By B. T. P. Barker.

Intermediate Stock Influence.—In all the recent reports of the Institute reference has been made to the experimental work in hand on this subject. The results of the analyses of the juices of fruit from individual trees have been stated annually, and the conclusion has been drawn that, so far as the experiments have proceeded, the influence of the intermediate stock shown on vintage quality is very slight, if any. In Table A* the results of the 1914 analyses of the Dabinett juices obtained from trees under treatment in this investigation are given. The same type of results as in previous years is again shown. Individual trees show relatively wide variations in these analyses for all the characters examined; but on taking the average composition over the series of years during which fruit has been produced there is a marked tendency for the figures for individual trees to approach one another closely. There is, therefore, no reason to modify the conclusion previously arrived at as to the negligible effect of the intermediate stock in this direction.

Table B† shows the analyses of juices of certain varieties which have been worked on the Paradise root stock with other varieties used as intermediate stocks. These results confirm the conclusion drawn from those with the Dabinett variety referred to in Table A. The difference in the two series of experiments is that in the case of the Dabinett trees all except B 190-195 are worked on the free stock and, therefore, the root system of each tree differs, whereas in the case of varieties referred to in Table B the root stock is the same throughout, and therefore that factor can be ruled out of consideration in the comparison of results of the individual trees.

The striking feature with all the varieties included in Table B is the marked reduction in acidity below the normal for the variety worked in the ordinary way on the Free stock. This reduction in acidity cannot be attributed to intermediate stock influence in view of the Dabinett results for trees B 190-195 referred to in Table A. It corresponds, however, with the reduction in acidity noted in a previous section of this Report for other vintage varieties worked direct on the Paradise root stock. It therefore appears probable that the Paradise root

* See pp. 122 and 123. † See pp. 124–127.

stock has a marked effect in lowering the acidity of the juices of the fruit below the standard normally obtained when the same varieties are worked on the free or crab stock. Referring to individual cases, Cap of Liberty in Table B shows acidities ranging between ·41 and ·69. The normal acidity for the variety on the free stock is from ·75 to 1 per cent. In the case of Dabinett, the acidities range between ·05 and ·1 per cent. On the free stock this variety generally shows an acidity of ·1 to ·25 per cent. The Kingston Black acidities range between ·2 and ·48 per cent. The normal acidity for this sort on the Free stock is from ·4 to ·65 per cent. The Sweet Alford acidities range from ·06 to ·12 per cent. as against the normal acidity of ·1 to ·2 per cent. on the free stock. This feature has been noticed regularly each year since the trees have borne sufficient fruit for analysis, so that the question of seasonal influence can be ruled out. It is evident, therefore, that in attempting to estimate possible intermediate stock influence in connection with the trees dealt with in Table B a considerable allowance must be made for the Paradise root stock influence; and it is desirable to wait until more extensive records are available before laying down any average standard of composition of those varieties on the Paradise stock.

The reduction in the acidity of the juice of the fruit caused by the use of the Paradise root stock has an important bearing not only on vintage questions but also in connection with the culture of market varieties of apples. The extent of the reduction is sufficient to produce an appreciable effect on the flavour of the apple, which will tend to appear sweeter than one of the same variety grown under similar conditions on the free or crab stock on account of the lower acidity. Hence certain dessert varieties with normally low acidity on the latter stocks will tend to appear more insipid off the Paradise, while those with higher acidities will have the latter toned down and will seem to be of decidedly better flavour.

With regard to the other characters dealt with in Table B, viz., specific gravity, tannin, and rate of fermentation, the influence of the Paradise root stock is not yet so clearly marked as in the case of the acidity. It is true that the rate of fermentation is relatively high in nearly every case; but this may be due to the fact that the trees are still very young. As has been pointed out in previous reports, young trees normally yield juices possessing higher rates of fermentation than those from older trees. Taking the results of past seasons, however, in combination with those for 1914, there is ground for believing that the rates of fermentation are higher as a rule than those from similar trees on the Free stock. This point, however, cannot be considered definitely proved at present. A more detailed account of the work in connection with stock influence is now in hand, and it is hoped to publish it shortly.

Apple Root Stock Investigations.—Fruit growers familiar with the nursery side of apple growing are aware that, at the present day, three different classes of root stocks are used by nurserymen for budding and grafting purposes. The first group is the so-called "Paradise" class, which consists of certain types distinguished by having the following features in common:—the ease with which adventitious roots are given out at any point of the plant, the surface-rooting fibrous habit of the root system, and the dwarfing effect which it has upon the growth of the variety which is grafted or budded on to it. On account of this dwarfing effect on the growth, the trees are thrown into bearing at an earlier stage than is the case when the same variety is worked on one of the stronger classes of root stock. The second class of root stock is known as the crab stock, and the individual plants are derived from seedlings raised from pips taken from so-called "Crab" apples. Although at the present time there are a number of so-called "Crab" stocks used, probably very few of them originate from the true Crab apple. Most of them come from small crab-like apples found growing in a wild or semi-wild state in various parts of the country. The third class of root stock used is the free stock. These are obtained as seedlings by sowing pips collected from the pomace of cider apples in France and this country. The root systems of the crab and free stocks are much more vigorous than those of the Paradise class, showing less of the surface rooting fibrous habit, and presenting a more deeply penetrating tap root type. Instead of exercising a dwarfing effect on the grafted variety they encourage more or less strong growth and produce comparatively large trees which come into bearing less readily and later than those on the Paradise stock.

The Paradise stocks, of which there are evidently a number of types, do not present any difficulties of multiplication, being propagated either by cuttings or layers. By this means the number of plants of any one of the Paradise stocks can be multiplied indefinitely; and there is, therefore, no difficulty in obtaining any number of trees of a desired variety of apple on the same root stock, so long as a stock of the Paradise type is used. In the case of the free and crab stocks, however, the case is entirely different, since each plant has originated from a different seedling. As is well-known, if seeds of any variety of apple are sown, the seedlings show great differences in habit and character owing to the fact that all existing kinds of apples are apparently of what is called a multiple origin; that is to say, they are hybrids and not fixed varieties, and therefore do not breed true. When, therefore, apple trees are procured which are worked with crab or free stock, it may be taken for granted that no two of the root stocks are exactly alike, and on that account uniform results may not be obtained.

It has already been mentioned in the previous reports of the

Institute that the question of the investigation of the influence of the root stock on the tree has been under investigation. During the past season conclusive evidence has been obtained to show that the root stock is capable of exercising—in certain directions at least—an appreciable influence upon the character of the tree and the quality of the fruit.* It has, therefore, become a matter of importance to apple growers that the root stock question should be thoroughly investigated.

It has been stated above that some kinds of root stocks produce a dwarfing influence upon a tree, while others promote more or less vigorous growth, the fruiting characters being to some extent affected in the opposite direction. It is, therefore, important to ascertain what kind of root stock is the best to use for a certain variety, and also, as far as possible, how far the root stock ought to be varied according to the kind of soil on which the tree is grown.

It is with that purpose in view that the Institute, in conjunction with the Wye College Fruit Experiment Station at Malling, Kent, is undertaking an investigation of the various types of root stocks used in this country and abroad. At the Wye College Station attention is being directed mainly towards stocks of the Paradise type. At Long Ashton the work is concerned chiefly with stocks belonging to the crab and free classes. A collection of types of the various classes of stocks as used by the leading fruit nurserymen in this country and abroad has been obtained, and these types are now being classified and propagated with a view to testing the value of each in due course on certain selected varieties of market apples chosen as representatives of strong, medium and weak-growing sorts respectively.

It is already evident that the number of types of the Paradise class in general use is not extensive, and it will probably not be a matter of many years before the influence of each of these types can be thoroughly ascertained. In the case of the free and crab stocks the number of types is indefinite, since each individual seedling differs from all the others. In this case efforts must be directed to grouping the plants into a number of general types representing more or less clearly defined habits of growth. After this has been done, it will be necessary to select the most promising of each class for propagation, if it is found possible to propagate stocks of those classes vegetatively with success. Some preliminary work in this direction has already been done: and it seems probable that there will be no difficulty in propagating any of the selected types by means of root cuttings. Having selected from the crab and free types individuals of different degrees of vigor of growth, it is proposed to graft or bud

* See pp. 117 and 118.

them with the test varieties used in the case of the Paradise stocks. There will then be under trial a series of root stocks for apples representing a very wide range of vigour of growth. By this means it should be possible to ascertain more satisfactorily than has hitherto been possible the main points of root stock influence and the kind of stock best suited to individual varieties of apples and particular types of soil.

Examination has now been made of a large number of crab and free stocks at Long Ashton which have been collected from various sources. The root system of these stocks varies very widely. The two extreme types found are, in the one case, a root system which consists almost entirely of a few little-branched strong roots of the tap-root type, lacking in fibre and laterals. At the other extreme there is little sign of any coarse tap-root growth, the root system consisting almost entirely of a mass of fine fibres given off from the base of the stem and from the original weakly-developed main root. Between these two types all grades of variations have been found. There are coarse-rooted types, more branched than in the extreme cases, and showing rather more laterals and more fibre. Proceeding further in the scale, a stage is found in which the main roots are less coarse, the lateral system more strongly developed, and the fibres more numerous. In other cases the development of laterals is the striking feature, the main root system being comparatively little developed. Further along the scale a type is reached in which the laterals, although very numerous, are less strong, and a very large development of fibre is present. In such cases there is very little evidence of any main root system. Undoubtedly the most interesting types at present are those in which the roots consist of a mass of fibrous roots which are given out both from the original main root and the base of the stem. Members of this class evidently approach the Paradise type very nearly, and it is possible that further experience will show that some of them may prove as useful as the types of Paradise stock more commonly used. Particular interest attaches to such stem-rooting kinds on account of their resemblance to the Paradise class. It has been found that many of them will root quite freely from cuttings; hence no difficulty will be found with the propagation of such sorts. In this connection an effort is being made to obtain as many varieties as possible of apples which strike freely from cuttings and layers. In many districts local varieties are known to exist which possess this character. Generally such varieties show greater or less development of root excrescences, or burr-knots, on the larger branches. Already a number of these sorts have been obtained from various sources, and it is hoped that if any readers of this report are acquainted with such kinds they will communicate with me, and, if possible, assist in obtaining material for propagation.

TABLE A.—Composition of Dabinett Juices in Intermediate Stock Experiments.

	Order of Tree in Row. (Name of Intermediate Stock in brackets.)]	Composition of Juice, 1914.				Average Composition of Juice, 1908-14.			
		Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 deg. C.	Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Daily Fall in Specific Gravity at 27 deg. C.
A	1. (Morgan Sweet)	1·052	·14	·38	5·4				
	2. (Broadleaf Jersey)	1·043	·13	·45	5·5	1·062	·13	·36	8·1
	3. (King of the Pippins)	1·045	16	·33	5·7	1·057	·17	·31	8·8
	4. (Hardwicke)	1·044	·18	·32	8·5	1·060	·19	·37	9·4
	5. (Warner's King)	1·050	·14	·31	6·2	1·061	·17	·32	8·3
	6. (Bramley's Seedling)	1·053	·12	·34	4·0	1·059	·15	·37	8·0
	7. (Ecklinville)	1·055	·14	·32	6·0	1·061	·15	·32	8·5
	8. (Blenheim Orange)	1·061	·17	·50	5·7	1·059	·17	·37	7·7
	9. (Annie Elizabeth)	1·051	·16	·37	5·7	1·061	·17	·35	7·5
	10. (Newton Wonder)	1·052	·13	·31	6·7	—	—	—	—
	11. (Peasgood's Nonsuch)	1·054	·13	·31	7·1	1·056	·18	·27	8·9
	12. (Hollow Core)	1·053	·13	·35	6·8	1·059	·19	·33	8·1
	13. (Sweet Alford)	1·056	·13	·32	6·8	—	—	—	—
	14. (Broadleaf Norman)	1·054	·13	·30	4·5	1·057	·19	·31	7·0
	15. (Court Royal)	—	—	—	—	1·060	·20	·32	7·1
	16. (Ecklinville)	1·055	·12	·29	4·5	1·060	·19	·32	6·9
	17. (Bramley's Seedling)	1·053	·15	·29	4·0	1·060	·19	·32	7·6
	18. (Blenheim Orange)	1·060	·15	·37	5·7	1·062	·17	·33	—
	19. (Warner's King)	1·062	·12	·31	8·5	—	—	—	—

A	209.	(Annie Elizabeth)	1·056	·15	·40	8·4	1·060	·18	·35	8·1
	210.	(Morgan Sweet)	1·054	·09	·04	5·4	1·059	·15	·35	5·0
	211.	(,, ,,)	1·056	·08	·40	6·5	1·059	·16	·33	5·7
	212.	(,, ,,)	1·056	·10	·36	5·3	1·061	·18	·32	5·8
	213.	(,, ,,)	1·049	·08	·26	7·0	1·060	·15	·33	6·6
	214.	(,, ,,)	1·048	·10	·39	4·8	1·059	·17	·33	6·6
	215.	(Newton Wonder)	1·051	·09	·36	6·6	1·064	·17	·34	—
	216.	(,, ,,)	1·059	·11	·36	6·1	1·062	·17	·34	—
	217.	(,, ,,)	1·053	·11	·31	5·0	1·059	·17	·27	—
B	190.	(On Paradise stock)	1·057	·05	·25	11·2	—	—	—	—
	191.	(,, ,,)	1·051	·05	·29	8·5	—	—	—	—
	192.	(,, ,,)	—	·08	·23	—	—	—	—	—
	193.	(,, ,,)	1·053	·05	·24	11·0	—			
	194.	(,, ,,)	1·053	·09	·36	11·5	—	—	—	
	195.	(,, ,,)	1·051	·07	·24	10·0	—	—	—	—

TABLE B.—Composition of Juices from Bushes on Paradise Root Stock and Various Intermediate Stocks.

Name of Variety.	Intermediate Stock.	No. of Tree.	Composition of Juice, 1914.			
			Specific Gravity.	Malic Acid, per cent.	Tannin per cent.	Rate of Fermentation.
Cap of Liberty	Royal Jersey	41	1·056	·60	·30	13·0
Ditto	Médaille d'Or	54	1·046	·41	·22	—
Ditto	Ditto	58	1·048	·45	·19	12·0
Ditto	Ditto	61	1·048	·50	·24	9·0
Ditto	Broadleaf Norman ..	69	1·045	·47	·17	14·5
Ditto	Ditto	70	1·045	·50	·16	11·0
Ditto	Brown Jersey	75	1·049	·42	·23	12·2
Ditto	Royal Jersey	95	1·047	·48	·20	11·7
Ditto	Ditto	97	1·042	·48	·19	18·0
Ditto	Footlands No. II. ..	103	1·044	·43	·44	8·2
Ditto	Sandford Jersey ..	127	1·048	·47	·17	12·0
Ditto	Ditto	128	1·050	·50	·16	12·0
Ditto	Cummy Norman ..	143	1·057	·62	·38	13·2
Ditto	Silver Cup	163	1·060	·69	·39	8·0
Ditto	Broadleaf Jersey ..	181	1·048	·55	·25	11·2
Ditto	Ditto	182	1·045	·47	·18	10·7
Ditto	M. Jacques No. II. ..	203	1·052	·51	·22	6·2
Ditto	Improved Pound ..	288	1·049	·52	·20	11·7
Ditto	Ditto	252	1·042	·37	·12	13·5
Ditto	Ditto	253	1·040	·42	·12	10·0
Dabinett	Médaille d'Or	58	1·050	·09	·36	5·0
Ditto	Brown Jersey	75	1·056	·08	·40	—
Ditto	Sandford Jersey ..	127	1·048	·07	·27	8·0
Ditto	Ditto	128	1·050	·05	·24	8·3
Ditto	M. Jacques, No. II. ..	206	1·051	·10	·29	12·0
Ditto	Neverblight	243	1·052	·05	·34	10·0

Dabinett	Ditto	244	1·054	·07	·44	11·0
Ditto	Kingston Black Improved	266	1·055	·08	·38	8·8
Ditto	Ditto	267	1·050	·09	·35	8·1
Ditto	Red Streak	294	1·050	·06	·31	8·1
Ditto	White Styre	315	1·050	·08	·34	7·0
Ditto	Ditto	316	1·056	·05	·41	6·6
Ditto	Dove	370	1·045	·07	·26	8·7
Ditto	Ditto	190	1·057	·05	·25	11·2
Ditto	Ditto	191	1·051	·05	·29	8·5
Ditto	Ditto	192	—	·08	·23	—
Ditto	Ditto	193	1·053	·05	·24	11·0
Ditto	Ditto	194	1·053	·09	·36	11·5
Ditto	Ditto	195	1·051	·07	·24	10·0
Ditto	The Bell	393	1·057	·09	·45	13·0
Ditto	Thomas Hunt	405	1·058	·05	·44	8·5
Ditto	Sharp's Summer ..	538	1·050	·07	·36	10·5
Kingston Black	Royal Wilding	9	1·064	·30	·19	12·8
Ditto	Ditto	10	1·051	·29	·19	10·2
Ditto	Knotted Kernel ..	24	1·062	·32	·28	12·4
Ditto	Ditto	30	1·048	·24	·24	9·8
Ditto	White Bache	33	1·050	·21	·20	9·2
Ditto	Ditto	35	1·068	·50	·26	11·8
Ditto	Royal Jersey	44	1·058	·36	·25	11·2
Ditto	White Norman	51	1·048	·22	·18	9·6
Ditto	Ditto	52	1·052	·38	·22	10·4
Ditto	Ditto	53	1·052	·34	·17	—
Ditto	Médaille d'Or	58	1·052	·32	·23	9·8
Ditto	Ditto	62	1·064	·35	·23	12·8
Ditto	Ditto	63	1·055	·28	·33	10·4
Ditto	Broadleaf Norman ..	67	1·058	·37	·26	11·6
Ditto	Ditto	68	1·063	·36	·30	12·6
Ditto	Ditto	71	1·058	·46	·25	11·6
Ditto	Brown Jersey	78	1·060	·41	·21	—
Ditto	Strawberry Norman ..	84	1·056	·31	·28	10·2
Ditto	Fréquin Audièvre ..	90	1·064	·43	·17	13·2
Ditto	Redstreak	115	—	·29	·20	—

TABLE B.—*Continued.*

Name of Variety.	Intermediate Stock.	No. of Tree.	Composition of Juices, 1914.			
			Specific Gravity.	Malic Acid, per cent.	Tannin, per cent.	Rate of Fermentation
Kingston Black	Redstreak	117	1·059	·39	·27	9·8
Ditto	Bramtôt	143	1·054	·35	·25	12·5
Ditto	Sandford Jersey ..	127	1·051	·30	·22	11·5
Ditto	Ditto	128	1·051	·42	·21	8·7
Ditto	Ditto	129	1·054	·44	·25	—
Ditto	Chevalier	134	—	·33	·25	—
Ditto	Harry Masters	138	1·060	·36	·30	—
Ditto	Argile Grise	153	1·050	·45	·22	11·7
Ditto	Ditto	156	1·058	·46	·26	—
Ditto	Brown Thorn	160	1·057	·32	·27	11·7
Ditto	Silver Cup	163	1·058	·30	·30	—
Ditto	Ditto	164	—	·33	·27	—
Ditto	Broadleaf Jersey ..	183	1·055	·32	·22	10·8
Ditto	Dabinett	195	1·058	·31	·25	9·6
Ditto	M. Jacques No. 2 ..	204	1·040	·20	·32	—
Ditto	Ditto	206	1·046	·47	·19	8·0
Ditto	Cherry Pearmain ..	215	1·058	·32	·20	7·0
Ditto	Eggleton Styre	244	—	·32	·26	—
Ditto	Ditto	225	1·048	·42	·25	—
Ditto	Ditto	226	1·054	·46	·20	10·7
Ditto	Ditto	228	1·056	·34	·20	11·2
Ditto	Neverblight	247	1·055	·33	·18	11·0
Ditto	Cap of Liberty ..	253	—	·24	·16	—
Ditto	Kingston Black Improved	268	1·055	·35	·19	11·0
Ditto	Improved Pound ..	285	1·056	·39	·22	—
Ditto	Ditto	286	1·054	·45	·18	—
Ditto	Ditto	288	—	·24	·21	—

Kingston Black	Redstreak	298	1·040	·22	·18	—
Ditto	Woolston Spice ..	305	—	·40	·20	—
Ditto	White Styre	317	1·041	·25	·18	7·2
Ditto	Ditto	319	1·054	·32	·18	-
Ditto	Red Foxwhelp ..	324	1·054	·33	·24	13·2
Ditto	Court Royal	342	1·045	·20	·15	9·0
Ditto	Rouge de Trèves ..	352	1·051	·47	·16	8·1
Ditto	Doux Amer	360	—	·28	·23	—
Ditto	Ditto	365	1·040	·22	·22	8·0
Ditto	Dove	373	1·052	·43	·18	—
Ditto	Thomas Hunt	406	1·042	·24	·15	7·8
Ditto	Victoria	411	—	·24	·18	—
Ditto	Ditto	414	1·057	·37	·15	10·2
Ditto	Ditto	415	—	·33	·18	—
Ditto	Crenière	436	1·058	·40	·21	—
Ditto	Bealy Down Pippin ..	456	—	·48	·13	—
Ditto	Chiffers	492	—	·34	·17	—
Ditto	Ditto	254	—	·17	·13	—
Ditto	Ditto	256	1·070	·21	·19	14·0
Sweet Alford	Knotted Kernel ..	24	1·056	·09	·16	—
Ditto	Médaille d'Or	58	1·048	·07	·14	—
Ditto	Footlands No. 2 ..	102	—	·06	·19	—
Ditto	Sandford Jersey ..	128	—	·07	·15	—
Ditto	M. Jacques No. 2 ..	203	1·044	·08	·15	—
Ditto	Improved Pound ..	288	1·052	·09	·14	5·0
Ditto	The Bell	393	1·053	·07	·16	12·0
Ditto	Victoria	411	1·056	·12	·13	—
Ditto	Ditto	414	1·055	·08	·16	11·7
Ditto	Grafted direct on Paradise root stock	328	1·051	·11	·13	11·1

INVESTIGATIONS ON TOBACCO SOILS.

By C. T. Gimingham.

In view of numerous experiments on tobacco growing, now in progress throughout this country, and of their special interest to fruit growers as leading to a possible supply of cheap and home-grown nicotine for spraying purposes, the following account of an investigation of a series of samples of American and African tobacco soils carried out at Long Ashton last season is here included, although the subject is somewhat outside the general scope of the work.

The American samples were taken from soils which had long been under cultivation for tobacco, and were known to produce excellent crops of good quality: the African samples, on the contrary, were from virgin soils only recently brought into cultivation which had grown at the most two crops of tobacco. The problem was to determine by a comparison of the American and African soil types in what particulars they differed from or resembled one another, and, if possible, to draw conclusions as to the likelihood of the African soils growing tobacco of similar quality to that grown on the American soils. The essential details from the report which was prepared are given below.

The following samples were received :—

American.

1 *Wilson, N. Carolina.* Almost white coarse sand; faintly acid.
2 *Darlington, S. Carolina.* Almost white coarse sand; acid.
3 *Danville, Virginia.* Yellowish coarse sand; acid.

African.

1 *Amika Estate, New Clearing No.* 5 *Exten.* Dark-red rich-looking sandy soil; acid.
2 *Nachamba, Amika Estate (Old).* Similar to 1, but darker; neutral.
3 *Ntondwe Estate.* Dark soil, probably long in cultivation; neutral.
4 *Tekerani Estate (Old).* Black soil; faintly acid.

5 *Makoka Valley Estate.* Dark red, like 2 ; acid.
6 *Tekerani Estate (New).* Exactly like 4.
7 *A. Duvar, Ntondwe.* Exactly like 3.
8 *Amika Estate.* Exactly like 1.
9 *Amika Estate (New).* Like 1 and 8.
10 *Amika Estate.* Like 1 and 8.
11 *T. M. Partridge : Hombera Garden.* Black soil ; acid.
12 *T. M. Partridge : Froub Garden.* Dark soil similar to 11.
13 *T. M. Partridge : Lunzu Garden.* Black soil ; faintly acid.
14 *Nasengwe : Garden* No. 1. Red soil ; acid.
15 *Nasengwe : Garden No.* 2. Black soil ; much undecomposed organic matter ; acid.
16 *Nasengwe : Garden No.* 3. Black soil like 13 ; neutral.

After testing all the samples and making a preliminary examination, the following were selected, as representative of the various types, for more thorough investigation and analysis :—

American. Nos. 2 and 3.
African. Nos. 2, 3, 5, 6, 9, 13, 14 and 15.

(1) The results of the analyses are set out in the accompanying table. It is evident from the figures that the American soils (which are all of one type) differ essentially from the African soils, although the latter, naturally, vary considerably among themselves. In the first place, the African soils are all dark-coloured (dark red or black), whilst the American are very pale ; but the most important distinction lies in the higher percentages of plant food found in the African soils. Mechanically, the soils are all very sandy, the American even more so than any of the African, though the differences here are not so marked.

The only particular in which all the samples agree is in their uniform lack of more than traces of carbonate of lime.

(2) *The American soils* as a group may be described as very coarse-grained sandy soils of feeble water-holding capacity, and poor in all the elements of plant food. Judging from the analyses it seems probable that on these soils the tobacco crop must be supplied with large quantities of readily available artificial manures (such as sulphate of potash, superphosphate, sulphate of ammonia, etc.), and this treatment would explain the rather high ratio which the available potash and phosphoric acid bears to the total amount present. It is known to be a better plan in America to bring a poor piece of land of a sandy nature into a proper state of fertility by the use of fertilisers than to grow the crop on richer but heavier soil.

(3) *The African soils* on the other hand are sandy soils of good water-holding capacity (on account of the high percentage of organic matter) and well supplied with all the elements of plant food. It is probable that these soils at present need no extra fertilising.

although, since tobacco makes specially heavy demands on the potash present, the crop would possibly respond to dressings of sulphate of potash. If, however, the soils are cropped continuously without manure of any sort they will no doubt approximate more and more to the condition of the American samples.

(4) The chief differences may be expressed as follows :—

Compared with the American soils, the African soils

(1) are much darker in colour ;
(2) contain much more organic matter (humus) and nitrogen ;
(3) contain more phosphoric acid and potash ;
(4) contain rather more of the finer grades of soil particles.

It appears probable that these American and African samples differ essentially in that, in the one case the plant food (especially the nitrogen) must be supplied in the form of readily available artificial manures whilst, in the other it can be obtained, in somewhat different form, from the natural reserves of the soil.

Therefore, even if the possible effect of differing climates and rainfall is set aside, there are many points of difference between the two groups of soils, any one of which may have an important influence on the quality of the crop.

Percentage of Air-dry Samples.

	American.		African.							
	2	3	2	3	5	8	9	13	14	15
Moisture	0·85	0·86	5·51	2·83	1·77	2·13	5·6	3·58	4·39	5·2
Loss on ignition	2·82	1·48	8·84	9·43	5·75	7·27	10·16	4·66	4·72	7·32
Potash (Total)	0·089	0·082	0·253	0·142	—	—	0·268	0·45	0·185	0·103
Potash (Available)	0·015	0·023	0·027	0·031	—	—	0·038	0·016	0·019	0·012
Phosphoric Acid (Total)	0·116	0·085	0·227	0·289	—	—	0·217	0·112	0·097	0·076
Phosphoric Acid (Available)	0·072	0·049	0·079	0·112	—	—	0·085	0·084	0·048	0·063
Carbonates	nil	nil	0·04	0·08	—	—	trace	nil	nil	nil
Gravel and Sand	88·8	80·6	62·0	66·8	74·2	74·0	60·0	76·8	—	—

Explanatory Notes.

Moisture. The amount of moisture retained by a sample of air-dry soil is dependent chiefly on the percentage of finest particles (clay) and of organic matter.

Loss on Ignition. This is a measure of the amount of organic matter present, and is, at the same time, approximately proportional to the amount of nitrogen present.

Total Potash and Phosphoric Acid. These two constituents of the soil, together with nitrogen, are the most important plant foods. The total figures give the percentages soluble in strong acid.

Available Potash and Phosphoric Acid. This is the percentage soluble in 1 per cent. citric acid, and is an approximate measure of the amount readily available for the plant.

Carbonate of Lime. A fair proportion of this constituent is essential for the growth of most cultivated plants. Tobacco is, however, known to be intolerant of large amounts.

Fine Gravel and Sand. This gives an approximate measure of the mechanical condition of the soil.

NOTES ON TEART LAND.

By C. T. Gimingham.

Problems in connection with the scouring or "teart" land have received a considerable amount of attention during the last few years, and since the appearance of a paper on the subject in the *Journal of the Board of Agriculture* in October, 1910, the work has been carried somewhat further. A paper dealing with this later work has recently been published in the *Journal of Agricultural Science* (Vol. VI., p. 328), entitled "The Scouring Lands of Somerset and Warwickshire," and the main points are here summarised.

It may be said by way of introduction that the scouring lands referred to are certain areas of old pasture which, at some times of the year—particularly the Spring and Autumn of wet seasons—grow herbage which causes cattle feeding on it to become very ill owing to violent scouring. Cows in-milk are the worst sufferers, and great care has to be taken in the affected districts to keep any animals of weak constitution away from these fields.

The three suggestions most frequently put forward to account for the phenomena of scouring are (1) a bad water supply, (2) the presence of one or more particular species of plants in "teart" pastures, and (3) the presence of a specific organism. It is easy to show that neither of the first two of these suggestions can be substantiated. With regard to the third, it is true that at first glance there seems much evidence in favour of the view that the scouring is a definite disease due to a specific organism. All attempts to isolate a responsible organism have, however, proved useless; and, indeed, a further examination of the facts renders this biological theory of the origin of scouring highly improbable.

The existence of such land outside the county of Somerset was not for some time known to the writer, although many enquiries had been made. It is now, however, found to occur in Warwickshire, showing precisely the same phenomena under precisely the same conditions. The most striking fact in this connection is that all the scouring pastures in both counties are situated on the same geological formation—the Lower Lias; and further that the scouring districts occur only where this formation is not covered by Drift,

i.e., where the soils actually originate from the Lower Lias. The typical soil is an extremely heavy, sticky clay, and previous work had suggested strongly that it is the particular *physical condition* of these soils affecting the herbage that is at the bottom of the trouble. At all events the primary cause of the scouring is in some way closely associated with the soils.

In many cases scouring and sound fields lie closely adjoining, and it can then be readily observed that there is a marked difference in the texture of the surface soil in the two fields. In order to investigate further this difference, determinations of the density of some of the soils *in situ* have been made.

To obtain the soil density, small metal boxes (accurately 2 inches square) with removable top and bottom were used; and by taking a number of samples, the average weight of 8 cubic inches of the surface soil *in situ* could be obtained.

The greatest possible care was taken to procure all the samples in precisely the same manner; and fortunately for this purpose all these soils are almost entirely free from stones.

It was found that a sufficient degree of accuracy was obtainable by this method; and Table I. gives the figures for the densities in a number of cases.

In spite of some irregularities, it will be seen that the difference in texture between "teart" and sound land is reflected in the figures for the densities; these show, with sufficient consistency, a definitely lower density for the surface soils of the sound fields.

The contrast between these types of soil was also well illustrated in one or two cases by their respective hygroscopic properties. The samples in one locality were taken on November 9th, 1911, when some heavy but not continuous rain had fallen after the long drought of the summer, and the ground was not thoroughly soaked. The difference in apparent "wetness" between the soils of the "teart" and sound fields was so marked that it was difficult to believe that the same amount of rain had fallen on each. The soil of the sound field seemed dryer and was hard enough to make it difficult to get the samples, whilst the "teart" soils could be moulded with the fingers. Actually the percentage of moisture was distinctly *higher in the sound soil*, the mean figures for five samples in each field being:—

Sound, 31·2 per cent. moisture,
Teart, 25·8 ,, ,, ,,

The sound field in this case has no surface deposit of alluvial soil; its history differs from that of the surrounding pastures (all more or less "teart") only in the fact that, years ago, it was drained by open "cuts." The effect of this surface drainage is the only possible explanation of its superiority.

Similarly, in another district, where the sound fields lie at a lower elevation, are often flooded in winter and are covered by a thin deposit of alluvium, the mean figures for moisture were: sound, 33·27 per cent.; teart, 31·8 per cent.; the sound soil being again *apparently* dryer than the other.

TABLE I.

Locality	Wt. dry soil in 8 cub. in. in grams		Density	
	Teart	Sound	Teart	Sound
Queen Camel	160·0	114·5	1·22	0·871
Kingsdon	123·3	100·9	0·94	0·769
Pylle	128·2	106·1	0·98	0·809
Podimore	134·7	103·5	1·03	0·789

Six samples were taken in each field and the mean figures are given.

Such physical differences between soils as are here indicated might be due to a difference either in the proportions of the various sizes of the ultimate particles, or in the arrangement of the temporary aggregates and compound particles. In the former case, the results of mechanical analyses of the soils should provide the explanation. A considerable number of mechanical analyses have therefore been made. These show that both scouring soils and neighbouring sound soils are of the same type, and the observed differences in physical condition and texture cannot, therefore, be accounted for by referring them to the ultimate mechanical compositions of the soils.

These analyses have, however, brought out the fact that, in any pair of neighbouring fields there is, invariably, a higher percentage of organic matter in the soil with least tendency to cause scouring. This has been found to be generally true throughout the whole "teart" land area. Now the proportion of organic matter here unquestionably plays the most important part in the arrangement of the temporary aggregates and compound particles, and hence to a great extent determines the texture of the soil.

Since, therefore, the only persistent difference observable between sound and "teart" soils lies in the textures, it is justifiable to consider *the special texture of the soil as a leading factor in determining "teartness."* If this is correct, "teartness" would be expected to disappear when the soil texture is improved; and field experiments are needed to test the practicability of methods of improvement which suggest themselves if this view be accepted. There is, indeed, already a certain amount of evidence available which points in this direction. For example, "teart" pastures

when ploughed up and resown after a few years only slowly become "teart" again. Then, the effect of *surface* drainage is well shown in the case discussed above; and similar but less striking results have been effected elsewhere, though "teart" pastures do not as a rule lie wet.

Consideration of all the facts seems to render inevitable the conclusion that the texture of the soil plays the determining *rôle* in the production of scouring herbage.

The question then arises as to how the soil texture can affect the physiological properties of the herbage in this manner. There must certainly be a difference in the proximate constituents of grass from sound and scouring fields. The expressed juice and both fresh and dried material have been examined; but chemical analysis has so far failed to bring to light any substance to which the scouring properties could be attributed. This is, perhaps, not surprising in view of the difficulty of getting a really representative sample of the fresh material—a difficulty which is enhanced in the present instance because there is no means of knowing how far the herbage from different parts of the same field may vary in scouring properties. The facts, however, all point to the conclusion that scouring is due to the physiological action of some constituent or constituents of the herbage which are not normally present but only occur under special soil (and weather) conditions; and further that the soil conditions are determined by the texture and can be removed when the texture is appropriately changed.

A NOTE ON THE WASTE FROM SAW-MILLS AS A SOURCE OF POTASH.

By C. T. Gimingham.

Since the outbreak of war, various methods have been suggested for making up, to some extent at least, the deficiency in our supplies of potash manures caused by the cessation of the imports from Germany. A recent article by Dr. E. J. Russell* on the value of the ashes of hedge-clippings and trimmings as a source of potash, may be referred to in this connection, and also the work of the Forestry Department of the West of Scotland Agricultural College,† "the results of which indicate that there is a commercial possibility for the production of potash salts on a considerable scale from forest produce."

In addition to the potash obtainable from these sources there is a very large amount, of which at present little use is made, in the wood scraps, saw-dust, shavings from planing machines, etc., produced in enormous quantities in every saw-mill in the country. Is it not possible to avail ourselves of this source of supply? All that is required is a satisfactory and cheap means of burning the material, and proper methods of collecting, mixing, and disposing of the product. It is true that some of the wood-waste, in particular the saw-dust, is saleable as such in certain localities, and in limited amounts, and it is also true that the percentage of ash in the shavings and saw-dust, especially from some of the imported timbers is very small. But even when allowance is made for both these considerations, it remains a notable fact that there are very large quantities of waste wood available for conversion into ash.

In many saw-mills the wood-waste is already used as fuel for raising steam or for other purposes, and wood-ash is then a normal product. On the other hand, when the arrangements are not adapted for burning wood, the great piles of saw-dust and wood

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* Journal Board of Agriculture, Vol. XXI., No. 8, Nov. 1914

† See Leaflet No. 25, Board of Agriculture for Scotland; also G. P. Gordon, Trans. Royal Scottish Arboricultural Society, Jan., 1915.

shavings are often a serious source of embarrassment, and in busy times the rapid removal of such bulky material may be a matter of some difficulty.

For our present purpose, we may divide saw-mills into three classes :—

(1) Those using wood only as fuel.

(2) Those using wood mixed with coal as fuel.

(3) Those disposing of their waste wood otherwise than as fuel.

1.—*Mills Burning Wood Only.*—In most mills coming under this head, the ash obtained either accumulates in a heap and incidentally loses nearly all its potash by exposure to rain, or it is given away to whoever will take it. In some few cases it is sold to a neighbouring farmer at a nominal price.

Two types of ash may be distinguished—(1.) a comparatively coarse material obtained by burning the wood-waste in open furnaces or in gas producing plants, etc., and (2.) a very fine powder or flue-dust obtained from boiler-flues and chimneys. The latter material is the more valuable, sometimes containing as much as 9 or 10 per cent. of potash constituting a manure of almost the same value as kainit* ; it is always obtained perfectly dry, and is in a beautifully fine mechanical condition. A number of samples of both types of ash have been examined, and a few figures are given :—

	Potash Per cent. K_2O
Sample No. 4 Coarse Ash : very complete combustion ..	7·24
„ „ 5 „ „	5·08
„ „ 6 Flue-dust	9·11
„ „ 8 „ „	6·35
„ „ 9 „ „ coarser than Nos. 6 and 8 ..	5·89

At present the fact that the ash or flue-dust contains potash, and has therefore a definite manurial value, is often not realised, and no attempt is made to store it properly. The collection in quantity of such ash as is already produced does, however, present some difficulty, because the numerous smaller saw-mills turning out perhaps not more than 8 or 10 tons of ash a year are scattered all about the country.† The most promising plan would therefore seem to be to attempt to bring to the notice of both farmers and timber merchants in their respective localities the possibility of utilising wood ashes in place of kainit where potash manuring

* Wood-ash also always contains a small percentage of phosphates which add slightly to the manurial value.

† This is especially the case with the majority of English timber mills, and these are of special interest because the ash from English timber waste is usually richer in potash than that from imported timber waste.

is contemplated. At the same time, if even a small general demand sprang up, and the collection of the material could be satisfactorily organised, a considerable trade could probably be done.

2.—*Mills Burning a Mixture of Wood and Coal.*—From the fertiliser point of view the addition of coal ashes to the wood-ash is a very serious disadvantage, and the use of such a mixture cannot be recommended. If, however, the ash were a saleable commodity, there are many saw-mills where it would be quite possible to increase the use of wood thus increasing the output of pure wood ash.

3.—*Mills which do not employ Wood as Fuel.*—It has been already mentioned that in saw-mills where the waste is not burned it often accumulates to such an extent as to become a nuisance. If there were any sort of demand for wood-ash, local or general, a large number of firms who do not now burn their waste would find it worth while installing plants adapted to use wood as fuel either for steam-raising or gas-making. Moreover, in big towns, where there are many large saw-mills turning out hundreds of tons of wood-waste every week, it might very well pay to set up special plant for burning the waste for the express purpose of ash production. This is not the place to go into details with reference to these points, but it may be mentioned that the latter plan is now being tried in Scotland.

The matter can, perhaps, be summed up by saying that an increased demand for wood-ash, even though the price were low, could be met by an increased supply.

With regard to the value of wood-ash and flue-dust from saw-mill furnaces, it is important to remember that since timber is relatively poorer in potash than leaves, bark, twigs, etc., the material will in the great majority of cases contain less potash than similar ash obtained by burning the undergrowth and waste of forest and woodland. It will, therefore, constitute a somewhat lower grade and cheaper fertiliser. On the basis of the ordinary price of kainit, ashes such as those of which the analyses are given, should be worth anything from 25s. to 50s. per ton ; and since ash is almost purely a waste product, there is good reason to suppose that it could compete with kainit even in normal times.

The special suitability of wood-ash as a source of potash for plants is well known. It may, however, be useful to emphasize two points. In the first place, the potash in wood-ash is present for the most part as potassium carbonate, a salt very easily soluble in water. This is an advantage from the fertiliser point of view, since it means that all the potash is readily available for the plant ; but it necessitates care being taken that the material shall not get

wet by exposure to rain. The action of rain in washing out the potash is surprisingly rapid and complete; examples of this are given by Dr. Russell in the article previously referred to.

Finally, an important point is the necessity that will arise for very thorough mixing of any bulk of wood-ash on account of the considerable variations in the percentage of potash in different lots. For marketing, every consignment would have to be sold on its analysis; and would therefore have to be uniform in composition throughout.

Enough has, perhaps, been said to indicate that the possibility of the utilisation of waste wood from saw-mills as a source of potash is at least worthy of consideration. There would appear to be available a useful supply of "home-produced" potash fertiliser.

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An Abstract of this note has been accepted for publication in the "Journal of the Board of Agriculture."

ADVISORY WORK.

The following report deals with work of an Advisory character conducted at the Research Station at Long Ashton for the year ending September 30th, 1914. For the most part the matters upon which agriculturalists and horticulturalists in the Bristol province seek advice are dealt with by the existing county staffs concerned: and it is only the more special questions which are referred to the Advisory Centre. Problems relating to Forestry are dealt with by Professor H. A. Pritchard, the Advisor in Forestry for the Province; and Mr. Nixon, the Live Stock Officer for the Province, is responsible for all questions relating to Live Stock. Separate reports on these subjects are published elsewhere.

The Department has been asked by the Board to co-operate with the County Agricultural Staffs of the Bristol Province in the preparation of schemes for the reclamation and improvement of waste land, for utilising to best advantage existing food supplies, and for increasing next season's food crop. Matters coming under those heads have been dealt with from time to time as occasion required. The Department has also been concerned with experimental work on the canning of fruit pulp and the drying of fruit and vegetables which has been carried on at Studley College and Dunnington Heath.

There has been an increase in the number of enquiries made during the year under review. The number of such enquiries by letter was about 130. In addition a number of cases have received attention during the course of visits to farms and through personal visits of farmers and fruit growers to Long Ashton.

Economic Mycology.

The majority of specimens of diseased plants submitted for examination were attacked by pests of comparatively common occurrence, and the enquiries were directed for information as regards method of treatment rather than the identity of the pest. The following list of diseases, while not a complete record, serves to give an idea of the range of the enquiries:—

Diseased pear and other fruit blossom and young fruits: caused by the pear blossom bacillus in some instances, and by frost in other cases.

Potato tubers covered with mycelium of *Rhizoctonia violacea.*
Violet foliage attacked by *Phyllosticta violae.*
Cucumber leaves attacked by *Cercospora melonis.*
Peach leaf curl caused by *Exoascus deformans.*
Celery leaf scorch due to *Septoria petroselini.*
Apple and plum shoots attacked by *Monilia fructigena.*
Streak disease in Peas.
Pea foliage attacked by *Ascochyta pisi.*
Diseased Pea roots caused by *Thielavia basicola.*
Gooseberry shoots affected with *Phoma ribis.*
Cyclamen foliage flower-buds attacked by *Botrytis sp.*
Gooseberry foliage attacked by European and American Gooseberry Mildews.
Silver leaf of plums caused by *Stereum hirsutum.*
Plum branches attacked by *Eutypella prunastri.*
Decay of Rhubarb crowns : cause under investigation.
Canker of young apple trees caused by *Sphaeropsis malorum.*
Decay of turnips due to *Pseudomonas campestris.*
Tomato foliage attacked by *Cladosporium fulvum.*
Bitter pit in apples.
Fasciation in black currants.
Vine foliage attacked by Vine Mildew. which one ?
Disease of potatoes due to *Sporodesmium solani.*
Apple buds attacked by *Fusarium sp.* and by pear blossom bacillus.
Fungus growing in grass lawn.

The following special investigations have been made as the result of enquiries :—

(*a*) *Failure of Setting of Greengage Blossoms.*—The question of the failure of greengage blossom to set efficiently being due to bacterial action or to lack of suitable pollination having arisen, a series of biological examinations of greengage flowers at different periods of development was made. No definite evidence to connect the lack of crop of fruit with the presence of any specific bacterium or other organism was obtained.

(*b*) *A Disease of Tomatoes.*—Many enquiries having been received as to the cause and treatment of a serious disease of tomatoes, considerable attention has been given to this subject. The disease was found to be caused by a species of Pythium or an allied fungus, and attempts to trace its source and to limit infection have been made. The investigation is still incomplete.

Economic Entomology.

The number of enquiries received by letter for the year ending September 30th, 1914, was 17. Of these ten dealt with insect pests, three with animal pests other than insects, and four with spray fluids.

Of the 17 enquiries two were sent from members of county staffs, and three others at the instigation of the county officers.

The enquiries were distributed as follows :—

Coleoptera, 3.
Diptera, 3.
Hymenoptera, 1.
Lepidoptera, 1.
Hemiptera, 2.
Mites, 2.
Parasitic Worms, 1.
Sprays, 4.

This does not represent the whole extent of the advisory work done. In visits to growers and farmers on their own farms, to which great importance is attached as the best way of establishing close relationships with them, enquiries were received by word of mouth on problems of a far more difficult nature than any included among those cited above. On such occasions more useful information can be received and given than where enquiries are conducted through the post. These visits were paid for the most part to the larger growers and farmers, and much of the work done belongs properly to the Research Department. The subjects of reversion and big bud of black currants, and means of control against wireworms, etc., may be instanced. Fuller details of such enquiries may be found in the report of the Research Department.

The 10 written enquiries dealt with the following subjects :—

Bark Borers, *Scolytus sp.*, from Taunton, Somerset.
Raspberry Weevil, *Otiorhyncus picipes*, from Caradoc, Herefordshire, attacking apple grafts.
Nut Weevil, *Balaninus nucus*, from Ledbury, Herefordshire.
Frit Fly, *Oscinis Frit*, from Gloucester.
Frit Fly, *Oscinis Frit*, from Dundry, Somerset.
Pear Midge, *Diplosis pyrivora*, from Dawlish, Devon.
Red Ants, attacking apples on the tree, from Stoke Bishop, Gloucester.
Raspberry Moth, *Lampronia rubielea*, attacking Loganberries, from Worcester.
Capsid Bugs from Dawlish, Devon.
Apple Psylla, *Psylla mali*, from Dawlish, Devon.

Pear leaf blister mite, *Eriophyes pyri*, from Port Talbot, Glamorgan, and from Exeter.

Tulip Root of Oats, *Tylenchus devastatrix*, from Droitwich, Worcester.

Enquiries about spray fluids from Blagdon, Milverton, and Marston Magna, Somerset, and from Thornbury, Gloucester.

Special Investigations undertaken as result of enquiries.—Only one enquiry, that about Frit Fly, sent by the Gloucestershire Farmers' Union, needed a special investigation this year. A series of visits were made round the affected districts of Gloucestershire with a view to collecting information. The enquiry was not received until the middle of August so that at many places visited the oats had already been harvested. A certain amount of information was, however, collected, and it is hoped to add to this next year by further visits and experiments. Two special investigations were continued from last year, that of winter cover sprays, and that of the flesh colour of Rhode Island Red Poultry.

(*a*) *The action of Cover Sprays as Winter Washes for Fruit Trees.*—This investigation, which was started in the session 1912–3 as the result of enquiries as to the value of various Lime Washes, has been extended considerably and ought now to be regarded as coming under the Research Scheme, rather than under that dealing with Advisory Work. Reference is made to it here, since several trials of selected washes were conducted at suitable centres in the Province. A summary of this work is given elsewhere in this Report (pp. 85–87).

(*b*) *The Flesh Colour of Rhode Island Red Fowls.*—The work begun in 1913, was continued for several months during the present session. The results of series of feeding and other experiments serve to show that there is considerable variation in the flesh colour of individual birds, and that in the same bird the colour frequently varies to a marked extent at different seasons of the year. There was thus a lack of uniformity in the results, and only in one series of experiments was there any approach to regularity. In very few instances was the brilliant white colour characteristic of the birds at Lullingworth attained, although a less well-defined whiteness was common. There were also many cases of creamy-white colour intermediate between the extreme white and yellow classes. It seems not unlikely that the flesh-colour of the breed is comparatively unstable and subject to influence by various conditions. To ascertain the nature and action of those conditions would

probably require a somewhat elaborate investigation, and could only be carried on satisfactorily at an institution suitably equipped and staffed for research in poultry problems.

Cider-Making.

The following list of subjects will indicate the general character of enquiries relating to cider-making :—

Turbidity of cider caused by bacteria.
Cider sickness, acetification, ropiness, and other disorders of cider, and their treatment.
The manufacture of cider brandy.
The value of various types of sugars for artificial sweetening of cider.
The suitability and structure of glass-lined cement tanks for storage of cider.
The use of pure yeast cultures in cider-making.
The selection of cider and perry for bottling ; bottling methods ; condition in bottle ; and the prevention of sediment.
The production of jelly from cider apples.
Identification and vintage value of cider apples.
The feeding value of apple pomace.
General methods of cider-making.
The detection of salicyclic acid in cider.
The blackening of cider ; its cause and prevention.
The treatment of cider sickness by refermentation.
Types of cider suitable for export.
Methods of cleansing and disinfecting casks and the floors of cider factories.
Buildings and equipment required for cider-making.
The development of distinctive flavours in fermenting liquors by the use of special yeasts.
The comparative merits of samples of filter pulp.
The effect of chalky soils on the character of cider.

Chemistry.

The enquiries dealt with may most conveniently be grouped under two heads—Soil Problems and Miscellaneous Enquiries.

(*a*) *Soil Problems.* Eleven requests for advice as to the manuring or other treatment of pasture, fruit land, or glasshouse soils have been received (ten from Somerset and one from Hereford). These have involved the collection and partial analysis of 20 samples of soil.

To a certain extent each of the enquiries involves some special

investigation since a visit has to be paid to the farm and information collected, etc. ; but in addition to the above, the following may be referred to separately as having required more detailed work :—

1.—A request from the Imperial Tobacco Co., Bristol, to report on the nature, properties, and composition of a number of African soils now being planted with tobacco, as compared with some typical American tobacco soils. This involved the chemical and partial mechanical analysis of 19 samples of soil. Details from the report on this subject will be found on p. 128.

2.—An enquiry from Mickleton (Gloucester) with reference to a disease of tomatoes. The soil was suspected in connection with the trouble, and visits were made to the grower, some analyses carried out, and a series of experiments with seedling tomatoes set going.

3.—In connection with the work on the " scouring " lands of Somerset, of which some details are given on p. 132, samples of soil were collected from the Kineton district of Warwickshire and analysed.

(*b*) *Miscellaneous Enquiries.*

1.—The analysis of a sample of apple pomace.

2.—The analysis of a sample of lime for spraying purposes.

3.—The analysis of a sample of black currants for the presence of arsenic.

4.—The analysis of the manurial value of an excavated material.

5.—The investigation of a case in which hay was causing serious injury to horses consuming it. (The trouble was traced to the presence of abnormal quantities of *Linum catharticum* (Purging Flax), in the hay).

With one exception these enquiries came from Somerset.

Arrangements for the despatch of the manures for the Provincial Council's Manurial Demonstrations in Gloucestershire, Somerset and Wiltshire, involved a good deal of work, and an examination of samples of soil collected from all the centres has been carried out.

Miscellaneous.

Among the miscellaneous enquiries dealt with may be mentioned the following :—

The composition of cherry tree gum.

Ropiness in milk.

The care and renovation of old orchards and the establishment of new fruit plantations.
Value of seeds mixtures.
Taints in flavour of butter samples.
Relative susceptibility of individual varieties of apples to attack by Woolly Aphis.
Methods of withy culture.
A poultry disease.
The preparation of apple pectin.
Types of machines for dry spraying.
Methods of fruit bottling.
The composition, digestibility, and feeding value of spent hops.
The failure of setting of tomato blossom.
The methods for specific gravity determination of honey.